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ON THE INFLUENCE OF ANTISEPTICS ON THE ACTIVITIES OF LEUCOCYTES AND ON THE HEALING OF WOUNDS.

By C. J. BOND, F.R.C.S., Hon. Col. R.A.M.C.(T.),

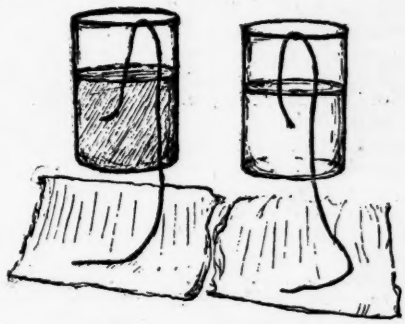
HONORARY CONSULTING SURGEON TO MILITARY HOSPITALS IN THE NORTHERN COMMAND; MEMBER OF THE MEDICAL RESEARCH COMMITTEE; HONORARY CONSULTING SURGEON TO THE LEICESTER ROYAL INFIRMARY.

PART I.

In the British Medical Journal, March 6th, 1915, I recorded some observations which seemed to show that the application of various antiseptics (even in a concentrated form) to the surfaces of aseptic wounds at the time of operation did not prevent primary healing. In the course of that inquiry certain effects on the blood were observed which suggested the desirability of a closer analysis of the problem.

In the first place, if any antiseptic in a concentrated form is applied to the tissues of a wound, efficient drainage of that wound is necessary, and it seemed important to devise some method of drainage which would not only carry off the blood and effused lymph but which would also serve as a trap to catch the emigrating leucocytes. In this way the cells could be recovered for microscopic examination at various intervals after operation, and the influence of various antiseptics could be observed on the behaviour of the leucocytes towards inert pigment particles, and albuminoid and other organic substances introduced into the wound.

A cotton thread of standard thickness and known number of fibres is boiled in water containing powdered indigo in suspension. By this means the thread is uniformly permeated with indigo granules, and can either be dried or kept in the indigo mixture and boiled before use on each occasion. A convenient length of this indigo thread is laid in the wound before suture and one end brought out at one angle of the wound. The usual sterile gauze dressing is applied.



1. 2.

Fig. 1.—Drawing from a photograph showing non-decolorization of indigo thread by capillary flow of serum or saline fluid. 1, Serum; 2, saline.

If such an indigo thread drain be removed from an aseptic wound, say twenty hours after operation, and examined in warm normal saline, the fibres of the thread will be found glued together and covered by coagulated lymph containing in its meshes large numbers of living leucocytes, of which a certain percentage will have ingested the indigo granules. The percentage of such indigo-loaded cells will depend on (*a*) the time the thread has lain in the wound, and (*b*) the treatment of the wound by antiseptics or other reagents at the time of operation.

If a wound made for the radical cure of hernia or for the removal of varicose veins be so drained under aseptic conditions, and if the indigo thread drain be removed after an interval of twenty-four to forty-eight hours, the portion of the thread which lies in the cavity of the wound will be decolorized. The extent to which this decolorization has been effected affords an indication of the activities of the leucocytes in three directions: (*a*) Their capacity to leave the vessels and to enter the thread; (*b*) their capacity to ingest the pigment granules; (*c*) their capacity to leave the thread and carry the indigo particles with them.

The objection will, no doubt, be made that the decolorization of the thread is not due to phagocytosis, but to the washing out of the pigment granules by the flow of lymph from the wound. The following experiment, however, shows that this is not the case.

Two small beakers were filled, one with normal saline and one with human serum. One end of an indigo thread was placed in each solution, and the other end was allowed to hang over the glass in contact with white gauze; in each case the fluid was drained out of the beaker into the gauze without washing the indigo out of the thread or depositing it on the gauze (Fig. 1). This shows that the decolorization of the thread drain while lying in the wound is not due to the flow of lymph or blood on to the surface of the wound, and further observations show that it is due to phagocytosis by leucocytes.

We may now ask what becomes of the leucocytes which have ingested the pigment granules. We know that in aseptic wounds the phagocytes do not leave the wound in the form of pus; they must, therefore, after entering the thread and ingesting the pigment, either (1) render the indigo granules unrecognizable by decolorization, or (2) eject the granules after temporary ingestion, or (3) transport the pigment from the thread back to the blood or lymph stream or the tissues. This question of the fate of leucocytes of different kinds, after emigration and phagocytosis, is a point of much interest about which it will be desirable to say more later; meanwhile, having shown that the decolorization of the thread is due to the vital activity of wandering cells, and is not merely a physical question of irrigation by fluids escaping from the wound, we are in a position to use this fact of decolorization and transportation of pigment as a means of testing the influence of various antiseptics on the activities of leucocytes while still living in the wound. The fact that the observations are carried out in the wound itself has considerable advantages. It serves to check observations made *in vitro*, and it is free from some of the fallacies inherent in experiments carried out under more abnormal conditions.

I have made a large number of observations on a considerable number of wounds under strict aseptic conditions in the human subject, and many antiseptics in different degrees of concentration have been tested by this method of the decolorization of the indigo thread. Further, the behaviour of leucocytes in relation to other substances such as egg albumin, serum albumin, starch albumin, glycogen, lecithin, has also been observed in wounds treated with and without antiseptics, though in this paper I propose to deal only with pigment particles. In some cases the wound itself has been washed out before closure with the antiseptic solution; in others the indigo thread alone has been saturated before introduction with various antiseptics in a concentrated form. By the first method the tissues from which the leucocytes emigrate are acted on by the reagent, and by the second method the pigment thread into which they pass.

The Effect of Antiseptics on the Decolorization of an Indigo Thread.

Without entering into the details of each case it may be stated in general terms that the application of a fairly strong antiseptic like mercury biniodide 1 in 1,000, or carbolic acid 1 in 20, to a wound such as that made for the radical cure of hernia, or for the removal of varicose veins, does delay to some slight extent the decolorization of an indigo thread placed in it as a drain.

In a wound to which no antiseptic solution has been applied an indigo thread of standard thickness will be almost decolorized in forty-eight hours, and will show very definite sign of partial decolorization twenty-four hours after insertion into the wound. If, on the other hand, the wound be treated before closure with any of the strong antiseptics, or if the thread itself be soaked in any of the same solutions, there will be only slight evidence of decolorization after twenty-four hours, and the thread will still show a blue tinge forty-eight hours after insertion.

The effect of salt solution, both in the 5 per cent. concentration and as normal saline, on decolorization, is about the same as in wounds in which no reagent at all has been used. This occurs when the wound is treated with the solution and when the thread is soaked with it before introduction.

Little difference could be detected (Figs. 2 and 3) in the effect on decolorization between the 5 per cent. salt solution and the 0.9 per cent. solution; and this, indeed, we should expect, because the stronger solution doubtless undergoes rapid dilution by the blood and lymph poured into the wound.

There is some evidence pointing to the fact that different individuals under similar conditions of wound treatment vary in the rapidity with which decolorization is effected; in other words, individual patients vary in the capacity of their leucocytes to (1) emigrate, (2) to ingest foreign particles, and (3) to transport the pigment granules so ingested under the stimulus of injury.

Fig. 2.—Drawing from a photograph showing indigo thread after forty-eight hours in wounds treated—1, without antiseptic; 2, with carbolic acid 1 in 20; 3, with salt solution 5 per cent.

In its clinical aspect this fact is of course familiar to surgeons, and it is no doubt associated with the observed differences in the rapidity with which blood and other effusions are absorbed in persons of different ages and in different states of health. It is a problem of much interest, and will, I hope, be the subject of further inquiry.

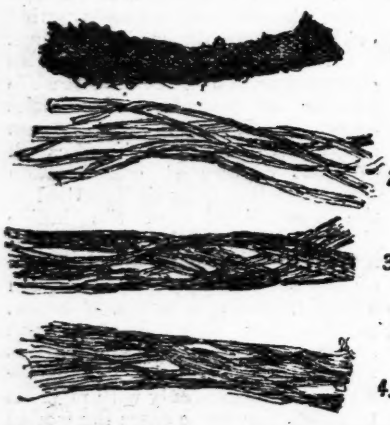


Fig. 3.—Drawing from a photograph showing the decolorization of indigo threads soaked in different solutions after forty-eight hours' exposure in the same wound. 1, Thread before introduction; 2, thread without any antiseptic; 3, thread with carbolic acid 1 in 20; 4, thread with salt solution 5 per cent.

The question now arises as to the method by which various antiseptic reagents exercise a retarding or accelerating influence on decolorization. We have already seen that, in the case of indigo particles at any rate, the removal of the pigment is the work of the leucocytes, and is independent of the blood stream and body fluids. In delayed decolorization the delay may be the result of

(1) Deficient emigration of leucocytes; or
(2) Impaired ingestion of pigment particles; or
(3) Failure on the part of the leucocytes to return to the tissues with their loads of pigment.

Before attempting to answer this problem we must first ascertain whether the indigo or other pigment has any injurious effect *per se* on the leucocytes. If an indigo thread drain, removed from a wound which has not been treated with any antiseptic, be teased in warm normal saline and the entrapped leucocytes be watched on the warm stage, the cells which contain pigment granules will be seen to throw out pseudopodia freely, though perhaps not quite so freely as unloaded cells.

The vitality and activity of these loaded phagocytes has been tested in various ways under different conditions. Thus indigo-containing cells were incubated in a saline fluid containing 0.005 per cent. calcium chloride to which carbon particles has also been added as recommended by Hamburger.[1] Although a considerable number of empty cells take up the carbon under these conditions, it is not usual to find many cells which already contain indigo taking up the carbon particles in addition. This point was also tested in the actual wound. Two pieces of gauze, one permeated with indigo and one with carmine, were placed one above the other on a healthy granulating surface, and the whole covered with protective. The entangled phagocytes were examined in warm saline twenty-four hours later. A large number of cells were found loaded with indigo and others with carmine particles, but only a few cells were seen which contained both kinds of pigment granules.

A composite cotton-thread drain, containing both indigo and carmine particles, was introduced into an aseptic wound and the same result obtained. I am inclined to think that this apparent disinclination on the part of leucocytes to ingest different kinds of pigment granules at the same time in wounds is not due to any injurious effect exercised by the indigo (or the carmine) on the cell, but that it is really the outcome of inertia on the part of the loaded cell, since all inert particles seem to have the same effect in this respect. I say inert particles, because it is necessary to distinguish between such bodies as carbon or other pigment particles around which no digestive vacuole is formed, and assimilable substances like albumin and starch, around which, when ingested, digestive vacuoles are formed.

Indigo-containing leucocytes recovered from an aseptic wound were also incubated in saline fluid containing neutral red in solution as used by Ehrlich, and as recommended by Achard of Paris as a test for living leucocytes. The cytoplasm of the indigo-containing cells takes up the neutral red freely while the nucleus remains unstained. Examined also on Ross's auxetic agar jelly to which atropine sulphate has been added, the indigo-containing cells show active movements.

From these and other observations, both *in vivo* and *in vitro*, we must, I think, conclude that the indigo granules, which are insoluble in the body fluids (except the bile), do not exercise any marked injurious effect on the white blood corpuscles.

Any delay that takes place in the removal of the indigo from the cavity of a wound which has been treated with an antiseptic may be regarded, therefore, as due to the action of that antiseptic solution, and not to any deleterious influence exercised by the indigo on the phagocytes.

We have already seen that in the process of decolorization of the indigo thread three different factors are involved, and the question now arises which of these three factors—*Emigration*, *Ingestion*, or *Transportation*—is responsible for the delay in the removal of the pigment.

Direct observation shows that a thread that has lain in a wound which has been treated by a strong antiseptic solution like carbolic acid 1 in 20 contains apparently about as many leucocytes as a thread which has lain in a wound to which no antiseptic has been applied. Of course, if the raw surface has been cauterized by an escharotic, then the coagulation of the tissue cells and the closure of the blood vessels will prevent the emigration of leucocytes into the cavity of the wound. This, however, does not occur when antiseptics are used in ordinary concentrations under surgical conditions in a recent wound. In several cases of septic wounds, complicated with extensive bone injury, which were being treated by daily irrigation and soaks of chloramine, tampons of indigo gauze were laid in the wound for twenty-four hours. These tampons were found on removal to be covered with pus cells and phagocytes, of which large numbers had ingested indigo granules.

In a case of operation for the radical cure of hydrocele in a young adult, after turning back the tunica vaginalis, the surface of the testis was freely rubbed with pure carbolic acid, with a view to the destruction of the secreting endothelial cells, a rubber tube was inserted down to the testis, and through this rubber tube an indigo thread drain was placed in contact with the cauterized tissues. On examining this thread after removal forty-eight hours later large numbers of leucocytes loaded with indigo granules were found amongst its fibres. Owing to the isolated position of the thread in the rubber tube, the phagocytes which had been carried into it by the flow of lymph had remained in the thread and had been unable to return to the tissues. In this case, although little or no decolorization had taken place, the result was not due to lack of emigration. Quinine has been for long supposed to have a special influence in preventing the emigration of white blood cells. An indigo thread soaked in a 1 per cent. solution of quinine hydrochloride placed in an

aseptic wound was largely decolorized in thirty-six hours; thus, whatever may be the case outside the body, quinine does not seem to prevent phagocytosis of pigment granules in a wound.

These facts all suggest that antiseptic solutions, surgically applied to aseptic and to infected wounds, do not tend to prevent the emigration of leucocytes from the injured tissues; in fact, as we shall see when dealing with organic substances, many antiseptic solutions in moderate concentration stimulate the flow of wandering cells. Neither does the evidence suggest that leucocytes which escape into wounds so treated are unable to ingest indigo or other pigment granules present in the wound.

What does seem to happen is that leucocytes which have so escaped and which have ingested pigment granules are less active in transporting their pigment loads back to the walls of the wound when antiseptics in a concentrated form have been previously applied to that wound.

The Return Immigration of Leucocytes in Wounds.

Metchnikoff showed that leucocytes which had emigrated into the peritoneal cavity to repel bacterial invasion returned in large numbers to the general circulation. Macullum later established the fact that white cells which had wandered into the lumen of the bowel during digestion returned to the portal and systemic circulation. The facts, however, are not so fully known in regard to cells which have emigrated in response to the stimulus of injury either of a mechanical or chemical kind. The problem of the return emigration of leucocytes from wounds has not yet been fully worked out in different tissues, in different kinds of animals, in different varieties of wounds.

In considering this problem it is necessary to distinguish carefully between infected and non-infected wounds.

In infected wounds the throwing off of the dead leucocytes as pus cells is in itself, of course, evidence that large numbers of the white corpuscles which escape from the blood vessels under such conditions do not return to the lymphatic or general circulation. But even in heavily infected suppurating wounds a consid rable number of phagocytes *do* return to the deeper layers of the granulation tissues which line the cavity of the wound.

Thus, if the granulating surface of an infected wound which is showing some attempt at repair, and in which, therefore, the contest between the defensive cells and the pathogenic organisms is not an entirely one-sided one, be dusted with powdered indigo or dressed with a layer of indigo gauze, and if after an interval of some twenty-four hours a small piece of the granulation tissue so treated be removed, sections cut at right angles to the surface will show a number of indigo-containing cells around the new capillaries in the deeper layers of the tissue. If the edge of the granulating area over which the new epithelium is spreading be carefully examined the indigo-containing cells may be sufficiently numerous in the underlying granulation tissue to give a blue appearance to the edge of the wound. Thus, while large numbers of the emigrating cells perish as pus cells, a considerable number survive and return to the tissues and the circulation. Moreover, there is a quantitative relationship between this "return immigration" of cells and the process of repair in the wound. This is seen clinically in the diminishing flow of pus which accompanies successful resistance to bacterial infection and the commencement of healing in a wound. The reduction of discharge is not wholly accounted for by diminished emigration.

The application of antiseptic solutions to granulating wounds, provided they do not cause death of the cells which compose the granulation tissue, does not seem to lessen the number of cells which contain pigment granules, though it does seem to exercise some influence on the number of cells which return to the tissues. A small wick of indigo gauze was laid in a heavily infected wound treated with compresses of eusol; large numbers of leucocytes loaded with indigo were found among the gauze fibres twenty-four hours later.

While this is the condition of things in the septic open wound, the picture presented by aseptic wounds in which suppuration is absent is quite different.

Here there is no throwing off of dead cells. All the cells which have reached the wound area must therefore either return to the circulation and the tissues or perish, and in their turn undergo removal by other phagocytes.

The Route followed by the Leucocytes in Return Immigration.

I have tried to detect the route by which the phagocytes regain the circulation by laying in the floor of an aseptic wound before suture a compound drain composed of a small indigo-bearing thread encased in or applied to one side of a larger thread of wool, as shown in Fig. 4.

FIG. 4.—Diagram showing arrangement of compound thread. I, Indigo thread; w, white wool skein.

On examining such a drain twenty-four or forty-eight hours later the indigo will have disappeared more or less completely from the indigo thread, and the leucocytes which have ingested it now occupy larger or smaller areas of the wool skein.

The degree of decolorization and the lines of retreat of the pigment-bearing cells seem to depend on certain accidental conditions, such as intimacy of contact between the indigo thread and the living tissues in the floor and sides of the wound. If the indigo thread lies, so to speak, free in the cavity of the wound imbedded in coagulated lymph, then the movements of the phagocytes are restricted, and they may only reach that portion of the wool skein which lies in direct contact with the indigo thread. Where the indigo thread is in direct touch with the living tissues the pigment-bearing phagocytes seem to return directly to the tissues in preference to entering the meshes of the wool fibres, though these are, of course, crowded with freshly emigrating cells which have not yet reached the indigo granules.

Further, the nature and vascularity of the tissues with which the pigment thread lies in contact also exercise an influence on the return flow. For instance, fatty tissues do not offer a favourable site for return immigration. The fibrous aponeurosis of the external oblique (in hernia wounds), if roughly handled and deprived of its feeble blood supply by gauze stripping, does not afford as favourable a clearing ground for rapid decolorization as the more vascular subcutaneous tissue.

This composite thread drain can also be used to test the effect of antiseptic solutions on this current of return immigration.

Fig. 5 shows cross sections of two such drains. In No. 1, from an untreated wound, the phagocytes have removed the indigo from the indigo thread and deposited it in the wool skein. In No. 2, from a wound washed out with mercury biniodide, 1 in 1,000, the cotton fibre has undergone little or no decolorization and the wool skein is still white and contains only a few indigo-laden cells. In this case the delayed decolorization of the thread in the wound treated with the antiseptics is not due to failure in either emigration or ingestion because the indigo thread is crowded with loaded leucocytes (Fig. 6).

FIG. 5.—Drawing from photograph of cross sections of composite indigo and wool drain after removal from wound (+ 5 diam.). 1, From untreated wound, shows decolorization of indigo thread and deposit in wool drain. 2, From wound treated with mercury biniodide 1 in 1,000, no decolorization of indigo thread, no deposit of pigment in wool drain.

I also tried to test this problem of the route followed by the phagocytes in return immigration and the influence of different tissues upon it by laying an indigo thread in one angle of the wound and a white cotton thread of like size but free from pigment in the other angle. When examined twenty-four hours later, very few pigment-laden leucocytes were found in the white cotton thread. The phagocytes seem to take the shortest route to the tissues as far as the coagulated lymph and blood which occupies the cavity of the wound will allow, and the cells do not seem to make their way to other foreign substances in other parts of the same wound. This is in harmony with the previous observations that leucocytes which have

already ingested one kind of pigment do not seem very active in ingesting a second variety. In view of the clinical phenomena associated with the spread of infection and the inflammatory reaction which accompanies infection, I also attempted to ascertain whether any extensive migration of pigment-laden cells occurs in the tissues which surround the wound, or, more accurately, whether, having emigrated and ingested foreign substances at the seat of injury, and having returned to the tissues, these pigment-laden phagocytes re-emigrate at the site of a neighbouring wound. To test this point an indigo-thread

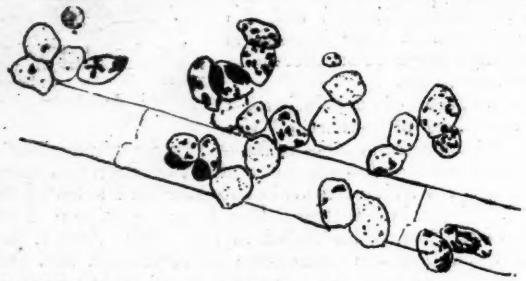


FIG. 6.—Drawing from a photomicrograph showing phagocytes containing indigo granules lying on and around a cotton fibre from the wound in Fig. 5, 2 (× 500). It illustrates the fact that absence of decolorization is not due to failure in emigration or ingestion on the part of the leucocytes.

drain was placed in one incision in a case of operation for varicose veins, and a white cotton unpigmented thread was placed in a neighbouring incision a little above the first. When removed, twenty-four hours later, no indigo-bearing cells were recovered from this white thread in a neighbouring wound.

Mention has already been made of the fact that no extensive ingestion of both kinds of pigment by the same cells occurs in two superimposed pieces of indigo and carmine gauze placed on a granulating wound. The same is true of aseptic wounds. Thus, a compound pigment thread containing both carmine and indigo particles removed from such a wound contained both indigo and carmine-loaded cells, but few cells carrying both blue and red granules.

Further observations are needed, but it seems probable that the "return immigration" of phagocytes is not entirely a question of chance, but is subject to a chemiotactic influence just like outward emigration. This does not, of course, mean that the element of chance does not play a large part in the movements of wandering cells in both the outward and the return journey.

Jennings and others have shown that the response of the amoeba and other protozoal organisms to attracting and repelling substances, and to physical stimuli, largely consists in movements of trial and error. The organism assumes various experimental positions along a line of least resistance, and this is probably true of the white blood corpuscles in man.

The Influence of Antiseptic Solutions on Return Immigration.

I have already spoken of the effect of a previously applied antiseptic on the process of decolorization of the indigo thread, and on the movements of the pigment-laden leucocytes in the composite cotton and wool thread. I have shown that the application of a strong reagent like pure carbolic acid to the surfaces of a wound made for the radical cure of hydrocele does not apparently reduce the numbers of wandering cells which crowd into the cavity of the wound, or the ingestion of the pigment by these cells. Evidently the effect of antiseptics used surgically does not check the emigration of leucocytes or their phagocytic activities as far as pigment is concerned—in fact, as we shall see later when dealing with organic substances, emigration is in some cases accelerated. It is, however, quite possible that emigration and phagocytosis may be going on freely, and yet the healing of such a wound may be prejudiced by the accumulation of the phagocytes in the cavity of the wound.

The delayed decolorization of the indigo thread which occurs in wounds which have been treated with certain reagents is probably partly due, therefore, to delayed return immigration.

Return Immigration in Suppurating Wounds.

The extent to which phagocytes which have flowed on to the surface of a suppurating wound can re-enter the tissues or the circulation depends upon, and is an indication of, the degree of injury which these wandering cells have sustained in their struggle with the pathogenic organisms established in the wound.

A certain amount of return immigration probably takes place on all granulating surfaces, as in all injured areas, with the exception perhaps of those wounds in which the infecting organisms have obtained complete mastery—a condition shown clinically by the cessation of discharge, together with signs of general toxaemia. Even in heavily infected granulating wounds, if a portion of the granulation tissue be excised after the surface has been dressed for two or three days with indigo, sections cut at right angles to the surface will reveal the presence of indigo-laden cells around the capillary loops in the newly-formed tissue. This occurs independently of the kind of antiseptic used provided that it is not strong enough to kill the cells.

I have attempted to investigate this question of the effect of antiseptic reagents on return-immigration in suppurating wounds experimentally in animals. Two small skin flaps were raised one on either side of the spine in the lumbar region in a guinea-pig. A piece of white gauze was laid in each wound so formed, and the flaps resutured over the gauze. Three days later (under an anaesthetic) the flaps were again raised, and indigo-saturated gauze was substituted for the plain gauze; on the right side no antiseptic was used, but on the left side the granulating surface was washed with carbolic acid 1 in 20, and the indigo gauze was soaked in the same solution before insertion in the wound, which was dressed later with the same lotion. The animal was killed two days later, and both wounds with the surrounding tissues excised and hardened in formalin. Sections embracing the entire thickness of the wounds show that indigo-laden phagocytes have wandered freely into the granulation tissue on both sides. In the wound to which the antiseptic had been applied the flow of pigment was less regular round the margins of the wound. It had not penetrated so far into the tissues except at one part, along the aponeurosis between the subcutaneous and muscular tissues at the deep end of the wound, where possibly the antiseptic had not penetrated so freely.

Pus—Not Only Composed of Dead Cells.

Various samples of pus from heavily infected wounds have been tested from the point of view of the capacity of the pus cells to ingest foreign particles *in vitro*. Starting with the preconceived idea, which I think is still shared

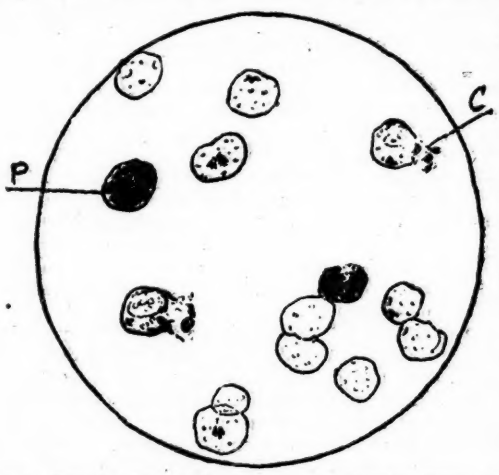


FIG. 7.—Drawing from a photomicrograph showing "pus" from a case of peritonitis incubated with indigo for eight hours. It contains a single field (one-twelfth water immersion and A ocular). Several "pus" cells are loaded with indigo granules and masses. P, Pus cell containing indigo; C, indigo escaped from ruptured cell.

by some surgeons, that pus is always composed of "dead" cells, I have been impressed with the fact that very few samples when incubated with pigment granules in normal saline have failed to give evidence of some capacity of ingestion on the part of a certain number of the cells of which the liquid is composed (Fig. 7).

If we regard capacity to flow round and ingest foreign particles as evidence of vitality then we must conclude that while most of the cells in pus from infected wounds are dead cells, yet a certain proportion are still living and capable under favourable conditions of active phagocytosis. This observation on the behaviour of pus cells *in vitro* is in harmony with the previously recorded activities of pus cells in the actual granulating wound. The proportion of living to dead cells bears some relation to the number and virulence of the infecting organisms and the digestive changes in the liquor puris.

In samples of pus taken from wounds infected with pyogenic organisms which show some attempt at successful reaction, the amount of carbolic acid in normal saline necessary to inhibit the ingestion of carmine particles by the pus cells when incubated for twenty-four hours is somewhere between 1 in 640 and 1 in 1,000.

This applies to pus removed from a wound and incubated with pigment *in vitro*. When, however, the pus cells are brought in contact with the indigo particles *in situ*, and are allowed to collect upon a layer of indigo-saturated gauze laid on a granulating surface and covered with protective, the incubation is carried out in the wound and a much larger number of indigo-containing cells can be recovered from the gauze. The proportion between living and dead cells, as judged by the test of ingestion, depends upon the healthiness of the wound. The strength of the acid carbolic solution necessary to inhibit the ingestion of pigment particles by the cells under these conditions must be judged by another standard. If indigo gauze soaked in normal saline be used as the control, then it will be found that ingestion of pigment goes on freely in gauze which has been soaked in acid carbolic solution, 1 in 60, before application to the wound. This method of testing the ingestive capacity of pus cells by incubating them with pigment granules in the wound itself affords a striking proof of the fact that many samples of pus contain considerable numbers of living leucocytes. It also affords a means of ascertaining the healthiness or unhealthiness of any wound, and of testing the effect of different antiseptic solutions on the life and activities of the leucocytes in the wound itself. Of the many factors which affect the vitality of leucocytes in a wound one of the most important (apart from the number and virulence of the infecting organisms) is the length of time which elapses after the cells have emigrated from the circulation and during which they have been exposed to the unnatural environment of an open wound. It is the recently emigrated cells which seem to retain the capacity to ingest foreign particles, and this fact bears on the very important problem of the efficient drainage of wounds. The object of drainage should be not only to provide for the escape of dead cells, but to further the emigration of living phagocytes.

We know that laudable pus (in other words, pus containing living phagocytes) indicates healthy activity in a granulating wound. It is possible that (in the absence of aseptic human leucocytes), if some means could be found to kill the ingested organisms without injuring the phagocytes, and to wash the cells so treated free from contaminating liquor puris, such revitalized pus would form a useful dressing for suppurating wounds.

The Difference between Suppurating and Non-suppurating Wounds.

Apart from the all-important factor of the presence or absence of infecting organisms, the differences between a suppurating and a non-suppurating wound are chiefly differences of degree and not of kind. We know that the tissues and the spaces between the tissues in the primarily healing aseptic wound are crowded with living phagocytes capable of ingesting both foreign particles and dead cells. We have also seen that a considerable number of the cells which compose the purulent discharge from a suppurating wound are also living cells capable of ingesting foreign material and acting as phagocytes. Emigration and capacity for ingestion are therefore factors common to both kinds of wound. The main difference between them lies in the fact that, while the proportion of phagocytes which find their way back to the tissues or the circulation is large in the primarily healing wound, it is relatively small in the suppurating wound. The degree of return immigration constitutes, in fact, the main distinction between the aseptic and the suppurating wound.

Summary and Conclusions.

I am fully conscious of the incomplete character of these observations. No attempt has been made to differentiate between the different varieties of phagocytes. Although this point has not been entirely lost sight of, the overwhelming numerical superiority and the greater importance of the polynuclear leucocytes in wound reactions has led me to limit my remarks at present to this group.

Further, the different ways in which different tissues and different organs respond both to different kinds of infecting organisms and to different kinds of antiseptic solutions is a wide and important subject. The work required to elucidate the method of such a comparatively simple reaction as the deportation of foreign pigment in the brain, liver, and other organs is very considerable, and must form the subject of further inquiry.

It will no doubt appear to many that the all-important factor of the infecting organism has not received adequate attention. The problem of wound reaction and wound treatment is, however, so enormous that some subdivision of the subject is absolutely necessary, and in this paper I have tried to deal only with the effect of various antiseptic reagents on emigration, phagocytosis (or ingestion), and return immigration of leucocytes when carrying pigment granules.

The outcome of the inquiry seems to be that antiseptic solutions in moderate degrees of concentration exercise less influence over emigration and phagocytosis than many surgeons have supposed. There are, however, reasons for concluding that antiseptics do exert a considerable inhibitive effect on the return immigration of living phagocytes. This aspect of the subject should, I think, be borne in mind in descriptions of the effect of different antiseptics in killing off pathogenic organisms in pus and other liquids *in vitro* and on the sterilization of wounds.

Provided efficient drainage is ensured, the surgical application of most antiseptic solutions does not apparently materially prejudice the defensive activity of the tissues in either infected or non-infected wounds. If it can be shown that the use of antiseptic reagents does at any stage diminish the numbers or inhibit the activities of pathogenic organisms, not merely *in vitro* but in the actual wound, then, although these reagents do undoubtedly cause the death of a certain number of body cells and prevent others from again reaching the tissues, this is a small matter if the invading organisms are at the same time materially diminished in numbers or in offensive capacity. It is the continuous and increasing effect of infection which is so inimical to healing. The occasional death of even large numbers of phagocytes is well borne if time be given to make up the loss. It is the strain of continued cell multiplication and the providing for the removal of organisms and cells that have perished in the struggle that tells.

The experimental introduction of pigment particles into a wound also throws a valuable sidelight on wound infection. In a general way the transportation of the pigment follows the same routes and the same lines of least resistance as those traversed by infecting organisms. The same peculiarities are apparent in the permeation of tissues and organs by the pigment granules. The liver, the spleen, the kidney, and the brain each presents its own special problem in emigration, phagocytosis, and return immigration.

Bearing in mind the fact that pigment particles are incapable of intrinsic movement, or multiplication, or growth, any transportation of pigment, in so far as it is not due to currents in the lymph or other fluids bathing the wound, must be due to the action of living cells.

It is interesting to find that the route taken by the pigment in the tissues generally coincides with the route taken by the infecting organisms; thus infection and return immigration roughly coincide. Several side issues of considerable interest arise out of this problem of the return immigration of phagocytes. Unless the ingested cocci and bacteria which are carried into the tissues by the phagocytes on their return journey are killed, or sufficiently attenuated to render them incapable of further growth, they may start into renewed activity on the death and disintegration of the cells which contain them. It is possible that some cases of recrudescent local sepsis may owe their origin to this cause.

The extent to which intrinsic motility and capacity for continuous growth enable pathogenic organisms to establish themselves in the walls rather than in the cavity or on the surfaces of a wound, no doubt varies with different organisms and in different tissues. The fact, however, that phagocytes are constantly transporting organisms from the cavity or the surface to the tissues which form the walls of a wound means that any adverse influence acting on these loaded cells on their return journey calculated to interfere with their power of retaining and digesting these ingested organisms is a source of danger. It is possibly in this way that antiseptic solutions act prejudicially when used too continuously or in a too concentrated form.

In connexion with this investigation I wish to acknowledge valuable help received from Captain Clare, R.A.M.C., and Sergeant Crane at the Pathological Laboratory of the 1/5 Northern Hospital, and from the resident staff, and R. Bertram, laboratory assistant, at the Leicester Royal Infirmary.

REFERENCE.

1 BRITISH MEDICAL JOURNAL, January 16th, 1915.

Notes on Military Orthopaedics.

III. THE SOLDIER'S FOOT AND THE TREATMENT OF COMMON DEFORMITIES OF THE FOOT.

BY

LIEUTENANT-COLONEL ROBERT JONES, CH.M., F.R.C.S.I. (HON.),

INSPECTOR OF MILITARY ORTHOPAEDICS, ARMY MEDICAL SERVICE.

(Continued from page 753.)

PART III.

HAMMER-TOE.

HAMMER-TOE is a deformity which usually affects the second toe, though it is common to find slighter degrees of the condition in other toes. It consists of flexion of the proximal interphalangeal joint and dorsiflexion of the metatarso-phalangeal joint (Fig. 1). The prominent knuckle of the proximal interphalangeal joint chafes on the upper of the boot, while the tip of the toe is pressed on the sole. Painful corns naturally develop at these points of pressure, making the man unfit to march.

FIG. 1.—Hammer-toe.

The causes are numerous: sometimes the deformity runs in families, but the commonest cause is the crowding of the toes in ill-fitting, badly designed boots. Hence it is common to find hammer-toe associated with hallux valgus.

Treatment.

In the adult operative procedure is indicated if we are to produce a quick and lasting recovery. Neither amputation of the toe nor an attempt at pseudo-arthrosis of the proximal interphalangeal should ever be undertaken. Amputation should not be done, because the absence of the second toe increases the tendency to the production of hallux valgus, and often leads to a second disability more serious than the original hammer-toe (Fig. 2).

FIG. 2.—The disability produced by amputation of second toe.

Some surgeons, when operating to correct the deformity, leave the articular cartilage on one side of the joint in order to obtain a new joint. My experience is that this is followed by recurrence so frequently that the operation should be condemned as uncertain.

Operation.

The operation found most uniformly satisfactory is a wedge-shaped excision removing the articular cartilage on both sides of the joint, so as definitely to ankylose the joint in extension. An oval piece of skin, including the corn, is excised over the prominent knuckle. A wedge, base upwards, including the joint, is then excised, of sufficient size to allow the toe to be straightened (Fig. 3). The flexor tendon is divided by tenotomy. The skin incision is then stitched so as to leave a transverse linear scar. The toe is fixed down to the toe-splint shown in Fig. 4, and the patient walks about, still wearing the splint inside his boots, for some weeks, to make sure that solid ankylosis occurs without any return of the deformity.

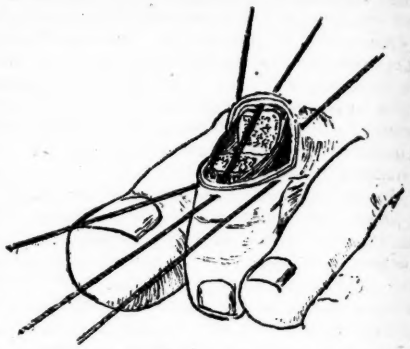


FIG. 3.—Wedge exsection of joint for hammer-toe.

FIG. 4.—Splint for hammer-toe.

DISPLACEMENT OF THE LITTLE TOE.

A displacement of the little toe, similar in nature to hallux valgus, frequently occurs, usually as the result of wearing boots which are too tight and too pointed. Occasionally the condition is congenital. The toe is displaced inwards either over the dorsal or under the palmar aspect of the fourth toe. In either position it is subjected to undue pressure in any ordinary boot, and therefore becomes painful.

Treatment.

This condition is very troublesome, and when it occurs in a soldier an operation is essential. The treatment which may be applied successfully in children has no place here, as the structures have become so contracted, especially the skin, that tenotomies, excisions, or simple splintings are wholly inefficient. Amputation of the toe is simple and effective in most cases, especially if no callosities have formed under the metatarsal head. In amputating it is advisable to make an ample flap to obviate the result of subsequent contractures and to secure a lax fleshy covering for the bone. If a callosity has formed, no pressure should be allowed upon that area until by rest and treatment it has become soft and normal. If the head of the bone is arthritic and the condition is complicated by exostoses or irregularities, these should be pared away. Only in very exceptional circumstances should the head of the metatarsal be removed, for, as pointed out in a previous article, this forms one of the points of support in the foot on which a soldier's marching powers depend.

METATARSALGIA.

Metatarsalgia is a peculiarly painful disability of the foot associated with flattening of the transverse arch. The characteristic pain is usually felt in the fourth metatarso-phalangeal joint, frequently in the third, and less often in the second. The pain is variously described as a sharp stab, a burning pain, or as if the patient was "stepping on a red-hot pea." The pain may come on suddenly as the patient is walking in the street, and cripple him, so that he has to hobble into a shop and get his boot off. The device adopted by most patients to obtain relief is to grasp the metatarsals in the hands and squeeze them so as to restore the transverse arch. In more chronic cases the affected toe becomes glazed and shows signs of trophic disturbance, while in some cases there is complaint of severe pain shooting up the leg.

Morton in his original description attributed the pain to pinching of the digital nerves between the metatarsal heads. The fact that relief is obtained by squeezing the metatarsal heads casts doubt on the truth of this. I described the condition fully in 1897, and stated that,

as the result of the study of dissections and frozen sections, I had come to the conclusion that descent of the transverse arch and consequent pressure on the nerves in the sole was the real cause of the pain.

Diagnosis is easily made by the characteristic tenderness elicited by pressing the offending joint between the finger and the thumb. In addition, obvious flattening of the transverse arch is usually present, and the fatty pad under the heads of the metatarsals is absorbed by the pressure of the descended arch, so that the "ball of the foot" feels unnaturally thin, and there are corns in the sole under the unusual points of pressure. The condition is therefore to be regarded as directly connected with overstrain of the foot, and is consequently associated with flat-foot.

Treatment.

Immediate relief can nearly always be given by removing the pressure of the body weight off the heads of the metatarsal bones by a bar behind them (Fig. 5).

FIG. 5.—Treatment of metatarsalgia. Bar on sole of boot behind the heads of the metatarsal bones.

The effect of this is to carry the body weight on the necks of the metatarsals. The heel of the boot should also be raised one-third of an inch on the inner side, as for ordinary flat-foot. A band of strapping round the bases of the metatarsals to prevent spreading also helps. These measures, combined with exercise of all the small muscles of the foot to restore the arch, and massage to relieve the pain and improve nutrition, will suffice to cure all early cases in the space of a few weeks.

The patient should then be warned against wearing narrow boots, which impede the free play of the fore part of the foot, and conduce to atrophy of the muscles of the foot from disuse.

In cases which have lasted for some time these measures do not suffice for a cure, though they give some relief.

Operation.

More drastic measures are required for the soldier's foot. Removal of the head of the offending metatarsal through a small dorsal incision completely relieves the condition in ninety per cent. of cases, even when the crippling effects have lasted a long time, and the patient is suffering so much that he asks for amputation of the foot. In the remaining cases it gives enough relief for the patient to be made comfortable with a bar across the sole of the boot.

After-Treatment.

The bar on the sole of the boot and crooked heel, already described, should be employed as an essential part of the after-treatment. The patient may then walk during the whole period of convalescence without injuring the site of operation, and so exciting new inflammatory changes.

PAINFUL CONDITIONS ABOUT THE HEEL.

The painful conditions about the heel most commonly met with may generally be traced to one of three causes:

1. Injuries or strain about the insertion of the tendo Achillis.
2. Spurs of bone and adventitious bursae under the os calcis.
3. Osteitis and periostitis from direct injury of the os calcis.

Injuries and strains about the insertion of the tendo Achillis are marked by pain about the back of the heel which is aggravated by walking and relieved by rest, but the pain recurs again if the patient is tempted to take exercise. The condition may be divided into three types:

1. *Tenosynovitis*, in which there is swelling due to effusion within the tendon sheath. This swelling extends some distance up the tendon, and is both palpable and visible.

The treatment is counter irritation, firm bandaging and rest. When the acute stage is passed the patient may be allowed to walk limited distances with the heel of the boot raised ¾ in., so as to relax the tendon and diminish the strain. If the condition tends to become chronic, the actual cautery may be used with great benefit, especially in the form of the heated needle.

2. *Bursitis* of the bursa under the insertion of the tendon into the os calcis. This is diagnosed by localizing the tenderness at the site of the bursa and by detecting a small area of fluctuation.

Treatment.—Relax the tendon by raising the heel ¾ in. Apply a band of strapping round the leg above the malleoli to act like the wristlet worn by workmen who have strained a tendon at the wrist. The patient should be instructed to walk a little every day, but should not be allowed to do an indefinite amount of walking; this is one of the difficulties connected with letting soldiers out from hospital on pass.

3. *Periostitis* at the site of insertion of the tendon, due to strain of the insertion.

The diagnosis is made by localizing the tenderness on pressure a little lower down than in the case of bursitis, and by the absence of deep fluctuation in the bursa beneath the tendon. *The treatment* by rest is the same as for the preceding condition.

Both these last-mentioned conditions may be present simultaneously and become chronic. The best treatment then is first to puncture the bursa or the inflamed area of periosteum several times with a hot needle. The process is exactly that known to the farrier as "pin-firing." The effect of this is to excite an active vascularization of the part, after which repair takes place more rapidly if the rest treatment is carried out.

Further, cauterizing a patient's heel deters him from wearing a boot and going out for too long walks, and gives the deep lesion an opportunity to recover while the surface blister is healing.

Irregular fibrous masses are sometimes noted in the Achilles tendon. These are usually the result of partial ruptures, and if large and persistently painful they should be removed.

SPURS OF BONE UNDER THE OS CALCIS.

Spurs of bone running forward into the plantar fascia or short muscles of the sole are frequently seen in skiagrams (Fig. 6). They often cause no symptoms. On the other hand, if the patient accidentally jumps on to a stone and bruises the periosteum over one of these spurs, it may become enlarged, or an adventitious bursa may develop under it. After this, the patient feels pain every time he puts his heel on the ground, and in the course of a long march.

FIG. 6.—Spur of bone under os calcis.

Treatment.

Make an incision along the side of the foot and gouge away the spur and tissue round it to make sure of clearing out the bursa and any chronically inflamed periosteum. The incision should, of course, not be made in the sole, as a scar in these regions is often itself the cause of trouble.

Osteitis and Periostitis.

Osteitis and periostitis of the os calcis often arise from bruising of the bone by a jump or fall from a height, or by injury due to gunshot. There may be no gross fracture, only some crumpling of the lamellae, which may be seen in a good skiagram. When a fracture occurs, the disability is often due to bony irregularities on the under surface of the bone.

Treatment is often unsatisfactory, and if the bony masses are felt in the sole under the heel they should be freely removed. Palliative measures are of no use in the case of a soldier; and one may state as a general proposition that a soldier with a badly-fractured astragalus or os calcis will not again be fit for service.

THE City Council of Boston has issued an ordinance establishing zones of silence in the neighbourhood of hospitals with fifty or more beds. Foot passengers, drivers of vehicles and street cars, and operators of motors are warned not to make any unnecessary noise within these zones.

THE LOUSE PROBLEM AT THE WESTERN FRONT.

BY

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(Continued from p. 749.)

"LOUSINESS."

IT is rather important to obtain definite information as to the condition known as "lousiness" for the following reasons:

1. At the time of writing the writer is unaware of any exact statements on what really constitutes lousiness of the soldier.
2. There is a necessity for establishing a standard by which to judge the condition of men or a unit.
3. To ascertain what general improvement is manifest in a unit after the operation of methods of instruction and combating.

The method of estimating the verminous condition of men was as follows. The shirt was examined in areas—right arm, left arm, right body-seam, left body-seam, and remainder of shirt. The numbers of lice on these areas were totalled. The areas taken on the trousers were—fork seam, running from front to back of waist, right leg and left leg. Eggs were estimated: Few (f.), abundant (a.), and very abundant (v.a.) Particulars were entered thus:

Unit. Date. Case.	When Last Bathed	When Shirt Last Changed.	No. of Lice.	Eggs	Trousers—when New or Last Treated.	No. of Lice.	Eggs	Total.
A. 9.10.15 No. 1	14 days	14 days	24	v.a.	6 weeks	46	a.	70

As it was not always possible, especially at the commencement of the inquiry, to obtain full particulars of men fresh from the trenches, the condition of the shirts was examined on arrival at the divisional baths. Later, more opportunity was afforded for examination of the condition of men straight from the trenches, and the particulars were obtained at the baths and billets. The result is shown in the two following graphs:

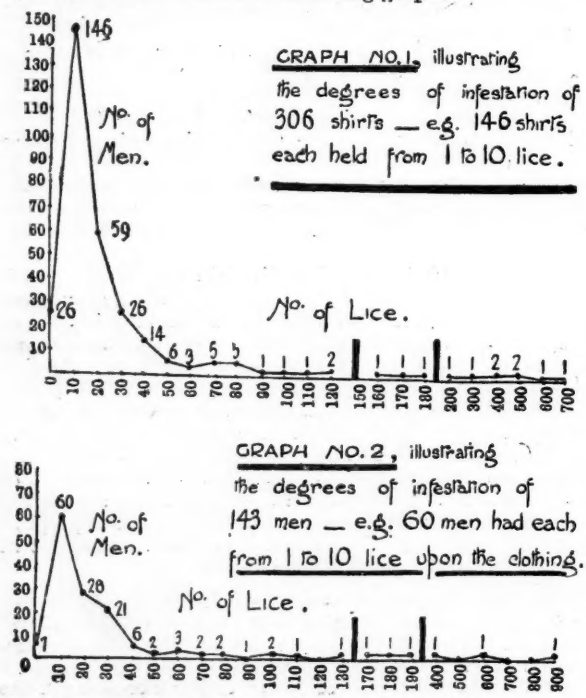
GRAPH NO. 1, illustrating the degrees of infestation of 306 shirts — e.g. 146 shirts each held from 1 to 10 lice.
No. of Men.
No. of Lice.
GRAPH NO. 2, illustrating the degrees of infestation of 143 men — e.g. 60 men had each from 1 to 10 lice upon the clothing.
No. of Men.
No. of Lice.

FIG. 9.—Graphs 1 and 2; Number of lice.

From the graphs the following particulars are obtained:

	Per cent.
Without any lice	4.9
With 1 and less than 10 lice	41.9
With 10 " " 20 "	19.6
With 20 " " 30 "	14.7
With 30 " " 130 "	11.2
With 130 " " 350 "	4.9
With more than 350 "	2.8
Total	100.0

From the examinations it was found that the trousers (there were no linings in most cases) contained about two-fifths of the number of lice contained on the shirt. The number found on the socks is negligible. The average lousiness per man of a unit is approximated thus: From the average lousiness of the shirts the average lousiness of the trousers was estimated, and the sum of these gave the estimated total lousiness. For example: Average number of lice per shirt, 10.5; estimated average number per trousers, 4.2; estimated total, 14.7.

Average Lousiness of Units of a Division.

Particulars of all the units examined are not given in full, but the following table dealing with infantry is given for illustration:

Unit.	No. of Men Examined.	Time since Previous Bath. (Mostly spent in Trenches.)	Average Lousiness.	Remarks.
A	19	7 days	10.5	—
B	8	16 "	11.9	—
C	17	10–14 "	14.4	—
D	29	21–28 "	15.2	—
E	10	18 "	16.4	Shirts renewed 11 days before leaving trenches.
F	50	14 "	18.2	—
G	45	18 "	19.1	Shirts renewed 10 days before leaving trenches.
H	33	14–21 "	22.7	—
K	51	28 "	27.8	—
L	12	14 "	31.4	—
Total	274		19.9	Variation, 10.5–31.4

These general remarks may be made:

1. Experimental error is not due to the fewness of examples, because most of the units, where most men were examined, show the highest degree of lousiness.
2. *Ninety-five per cent. of the men examined were infested.*
3. The condition of 274 infantrymen of the division shows, in round figures, a lousiness of *20 lice per man*, the variation being between 10 and 30. The division had then seen six months of hard work at different parts of the line.
4. Cases of lousiness above 100 have not been included.
5. Where clean shirts have been issued in the trenches, even for the short space of two days, the shirt at the end of that time attained the usual degree of lousiness. Young lice hatching from eggs on the trousers, and also adult lice, both evidently migrate to the shirt.
6. Clean underclothing, after men have bathed, becomes reinfected from the outer garments within half an hour.
7. Eighty-nine cases taken from infantrymen, newly out from England since a fortnight, showed a lousiness of 6.
8. Infantry transport sections of the division examined, of which 40 cases were taken, showed an average lousiness of 10, half that of the men in the line.

These men were in bivouac and changed and bathed regularly once a week, but because of the leather, the riding breeches were never treated with steam to kill the eggs.

9. The cyclists, 33 cases, living in billets, changed and bathed once a fortnight, showed an average of 11.
10. Twenty men of the Royal Field Artillery, living in billets, changed and bathed once a week, showed the very low average of 3.5.
11. As a contrast to this last example, 51 cases of the Royal Field Artillery newly out from England since a fortnight, and not changed or bathed in that time, showed the higher average of 7.9.

12. A most interesting case is that of certain railway engineers. These men lived together in a large room, changed and bathed every week, and had been at the front for three months. Not a single louse was found upon them.

It is suggested, by nature of the work among oil, that to this factor is partly attributed the freedom from the pest.

13. By reference to Graph No. 2 it will be seen that there is a break after 130. This produces the result that nearly 5 per cent. of men are what may be termed "maximum cases." These "horrible examples" showed the number of lice upon each man to be 168, 180, 190, 376, 400, 552, and 895. Another shirt held 1,355 lice and 4,260 eggs, while another showed 10,428 lice approximately and 10,253 eggs approximately. Reference has been made already to another extreme case.

"*Lousing*" *in the Trenches.*

The object of this inquiry was to ascertain from the witness of the men themselves what were the results of their self-searching for the pest. A certain division had served at two parts of the line, and the men from eleven different units were interrogated. Their average spell in the trenches had been about twelve days. The inquiry shows: (1) The average daily catch of the soldier was 8 at one sector and 9 at another; (2) the catch varied between 9 and 60; (3) that, from some source or sources, the man in the trenches is liable to a persistent daily visitation which insists on daily attention. The bag, as a general rule, is mixed, young and adults being obtained. Without encroaching on the section "Dissemination," it may be remarked that the main source of the young lice is undoubtedly the eggs on the clothing of the man himself. This accounts in part for the daily persistency of infestation. The difficulties of self-searching are great, and may be responsible for the overlooking of some of the large adults, but the constant recurrence seems to indicate that other sources, external, supply the large specimens.

It would be expected that soldiers living in the bare trench, where no dug-outs exist, would be more free from lice than soldiers living in dug-outs. The contrast is afforded in the example of the division under inquiry. At one time of the year the men were in bare trenches at one part of the line, and six months after they occupied dug-outs at another part. Men, however, were lousy to practically the same degree at each point. At the first place it was impossible to change clothing, and at the second they lived in close contact in dug-outs.

Lice and Dug-outs.

One of the most prevalent terms is "lousy dug-outs." Before conducting examinations in the first line of trenches, the impression obtained from conversation with soldiers—and others, too, of a more critical turn of mind—was that dug-outs were swarming with lice. The most comfortable form of dug-out is that which is completely boarded. More primitive types exist in which less wood is present and the floor is of earth. Five dug-outs of the boarded type were carefully searched. Included was a large one occupied by six machine gunners. Skilful assistance in this search was given by a stretcher-bearer, an ex-schoolmaster. The search in each dug-out usually lasted an hour, and was conducted in daylight with as much extra light as was possible to obtain from candles. In two cases the boards composing the floor were removed and carefully scrutinized, as were cracks and corners, with the fluff lurking there; kits, greatcoats, and sandbags were subjected to a like search. *In no case was a single live louse discovered.* Eight dug-outs with earth floors, at another part of the line, yielded a like result.

By reason of the military situation a most interesting experiment was terminated before culmination. The stretcher-bearer and the writer took measures to secure freedom from the pest. They slept with less clothing than worn by men in the line, but using two blankets, for two successive nights in a boarded dug-out newly vacated by three lousy soldiers. The conditions, therefore, were most favourable for picking up any lice present. After the first night an examination of the clothing and blankets gave a negative result. The night of that day the clothing and blankets were examined, as carefully as candle light permitted, and seemed clean, but the following morning the assistant's linings showed one louse and one flea. From one point of view, if this typical dug-out had been really a "lousy dug-out," it is reasonable to conclude that more lice would have been found on the clothing. It is quite possible, too, that the one louse found may have been obtained during the daily duties among the men and overlooked at the night examination, owing to the bad light.

It is not denied that lice may be present in dug-outs, but these evidently play a minor part in the harbouring and disseminating of the parasite.

Lousiness of Material.

Blankets.—In this connexion only two typical cases out of ten examinations are cited. The blankets of twenty-four infantrymen were searched. Their regiment had an average lousiness per man of 31.4, and had spent twelve days of the early autumn in the trenches. The blankets had been used for five days. Many were found free from lice. The highest number found on a single blanket was 6 (alive), and the total number of lice found was only 20 (alive), the average, therefore, being 0.8 per blanket. In the second example twenty-five blankets were examined in the winter, after being away from the men for about four days. Ten were free from lice; the highest number alive on a single blanket was 2, and the highest number dead was 4. The total numbers were 5 alive and 21 dead, the average, therefore, being about 1.0, dead or alive. The degree of infestation of the unit is not known, but is certainly no less than at any other time of the year. In sporadic cases blankets have been found exceedingly verminous, holding 20, 60, and more lice. This condition was always correlated with the fact that the men using them were very unclean. Blankets, therefore, are of minor importance as harbours and centres of dissemination.

Straw.—Straw sufficient for three men was placed in a corner of a room, infested with 535 lice, and left for nearly four and a half days. At the end of this time three clean men slept for three successive nights upon it. After the first night the total number of lice from all the men was 18, the second night 4, and the third night 7. The experiment shows that infested straw may be sufficiently lousy at the end of seven days to infest men using it. A similar experiment, using 1,000 lice and leaving the straw five and a half days, showed 2 after one night's use, 2 after the second night's, and none after the third night's. Straw was placed as above, and infested with 500 lice. After three hours, to allow the insects to scatter and accommodate themselves, N.C.I. powder was dusted on the straw. After eight hours three clean men slept upon it. Next morning the total number of lice from all three men was 7 alive and 6 dead. The straw was re-treated, and after the second night, with two men using it, no lice were picked up. The experiment demonstrates the efficiency of N.C.I. as a swift preventive of infestation from straw.

Paillasses.—Three paillasses, infested with 325, 500, and 500 lice respectively, were examined after eight days, and live lice were still found.

From the characteristic disinclination of the louse to leave clothing, it does not seem likely that straw will ever become very much infested.

DISSEMINATION OF THE PEST.

Three sources of infestation may be conveniently named: (1) Living places—dug-outs, billets, bivouacs; (2) material—blankets, straw, beds; (3) the soldier, with his clothing and kit.

Living Places.

Only the dug-out is discussed, but the same remarks apply to billets and bivouacs.

The main problem presents itself thus. Men state confidently that they go into the trenches clean, and in a few days find themselves infested. The general statement goes, "the dug-outs are lousy." It will be well to examine this critically.

If it may be assumed that a "lousy dug-out" was one which harboured twenty live lice, it is very unlikely that careful trained observation would not discover a single live specimen in thirteen dug-outs.

A man may have lice upon him all the time, and yet not feel any discomfort. Such men, it has been found, always

believe themselves to be clean, and generally declare it aggressively. Another unobtrusive but most important source of danger is the presence of eggs upon the clothing. There is the probability also of an unclean comrade.

The dug-outs with most unenviable reputation are those which are large and accommodate most men. Certain dug-outs—those of officers and senior non-commissioned officers—are frequently occupied by only one individual, and in these cases lousiness is not common. These living conditions, giving greater opportunities for change of clothing, for physical cleanliness, cleaner companionship, and often comparative isolation, are the converse of those of the men.

An important observation is the preference of the insect for remaining on warm material. This renders the probability of infestation from the soil very small, though, as has been pointed out, lice may endure surface soil conditions for seven days. In so doing it is quite possible for infestation to come from the ground. The chance of this, however, is very remote.

When a dug-out has been emptied of all kit, sandbags, etc.—such usually being the case when one unit makes way for its relief—most of the lice are removed also with that unit.

The weight of the evidence, therefore, goes to show that the dug-out itself is not an important factor in the harbouring and dissemination of the pest.

Material.

Previously mentioned facts show that, in exceptional cases, infested blankets may be centres of dissemination, but that, as a general rule, they are a minor source of dissemination.

From the preference of the louse for clothing worn next the skin or such clothing discarded, and the absence of lice upon blankets and empty sandbags used as bedding, it seems fair to deduce that straw and paillasses, which are colder habitats for the insect, will not be tempting places of sojourn for them.

The Infested Soldier.

Infestation from dug-outs and blankets being very slight, there remains the soldier himself. Concerning the conditions of the soldier, it will be well to recall to mind that 95 per cent. of soldiers who had seen six months' service were found lousy; that the average number of lice per man was twenty; that 5 per cent. (or 50 to a battalion of 1,000) were dangerous carriers, each bearing between 100 to 300 lice. Also, take the condition of a unit ready for the trenches after its few days' rest. During this time men are supposed to bathe and obtain a change of underclothing. Certain men have not bathed or changed owing to duty, or through shirking, and most have not had the outer clothing treated; that is, practically every man is still a carrier, while a certain few are likely to be in a worse condition.

Dissemination may possibly occur by three methods—accident, contact, and instinct on the part of the insect. In the first instance, the ordinary actions of everyday life, dressing or undressing, may dislodge the insects from the inner clothing to the outer, or from the outer directly to the clothing of a comrade, or indirectly via blankets or kit. In the case of contact, transference may be effected during close proximity for a short time, as in the case of doctor and patient, teacher and scholar. More favourable, and, to the mind of the writer, the principal conditions of transference are the long periods of proximity, engendering warmth and consequent movement of the lice, as when men are compelled to sleep closely together. The instincts of detecting and selecting the host seem at best too feeble to account for much dissemination.

The natural question is often asked, "How did the parasite first gain a footing in the army at the front?" In answer to this, the writer recalls the first day of mobilization, the pouring in of reservists to the barracks, among them many from the verminous slums, the mingling of mufti and khaki in the crowded rooms, and soon, with scant opportunity for obtaining anew the smartness and cleanliness of army life, the hurried dispatch to the seat of war. Once the louse was brought to the Expeditionary Force, the absence of facilities for washing and changing clothing, and the crowding together of troops, gave the parasite every condition favourable to lodging, feeding, multiplying and spreading.

METHODS OF PREVENTION AND DESTRUCTION.

Treatment of Cases Naturally Infested.

The condition of men was noted by the method already explained. The effects of various preparations were taken after one day, in most cases, and in a few cases for longer periods.

Treatment of Cases Artificially Infested.

Artificial infestation was carried on by taking a known number of lice from a newly-discarded shirt, and placing them on different parts of the body—that is, down the legs of the trousers, and inside the back and front of the shirt. After two to six hours—time sufficient for the insects to scatter, feed, and accommodate themselves to the new environment—the clothing and body were treated with preparations.

A large number of experiments with various insecticides was performed. The results, however, of both sets of experiments were unsatisfactory from the point of view of obtaining consistent and comparative figures. More experiments, impossible at present, are required. It may be that such exact figures cannot be obtained by the very nature of the experiments. It is quite possible that the preparations act with greatly varying results upon different men. When opportunity is afforded, other experiments will be conducted upon more cases, and for longer periods. Till the incorporation of such results, the figures available at present are withheld.

Insecticides act in two ways: (1) The effect upon the pest present, and (2) the deterrent effect on any of the insects present externally.

The vermicides used when the parasites were present produced either or both of the following effects—they killed or caused to evacuate. Use is made of certain convenient terms, as follows:

Killing efficiency is measured by the percentage of insects killed in a certain time by the insecticide.

General efficiency is measured by the sum of the percentage of insects killed, evacuated, and unaccounted for, in a certain time.

Deterrent efficiency is measured by the percentage of insects which the insecticide deters from reaching the body.

It is possible to give the following notes on certain insecticides.

N.C.I. (naphthalene 96 per cent., creosote 2 per cent., iodoform 2 per cent.).—This preparation is a speedy killing agent, and is the best all-round vermicide tested. The investigator himself prefers it to any other preparation. The following exacting test of its deterrent efficiency was made. Seven hundred lice were allowed to scatter in a sleeping bag improvised from a blanket. The writer used the preparation on the shirt, back and front, and on the riding breeches at the fork and as far down as the knees. The conditions were rendered as favourable as possible for the lice. Socks instead of putties were worn, the shirt neck was opened, and the sleeves rolled up as far as the elbows. Almost immediately after settling in the sleeping-bag lice were felt crawling in great numbers in the socks, on the arms, and a few at the neck—in fact, at those parts of the clothing and body not treated with the powder. Next morning, examination of the clothing and body gave the following results:

155 dead lice were shaken from the socks;
30 dead lice were found below the breeches' knees;
1 dead louse was found at the thigh;
No lice were found on the shirt.

The point of importance is that the powder was a complete deterrent. The duration of the deterrent efficiency of N.C.I. is illustrated in the instance where thirty men of a machine-gun section of infantry were supplied with the powder. The men since using have not been troubled. Most are of the opinion that the effect of one thorough application lasts five days. A few dusted the clothing every few days as a preventive measure.

Caution.—It is most important to remember that a too free use of N.C.I., particularly at the fork, causes severe smarting. For this reason it is recommended that an ointment insecticide be used in this region. However, used with ordinary care, N.C.I. has undoubtedly proved the best insecticide for general use on the clothing, material, and in living-places.

Vermijelli.—This ointment is very effective. It is found that the best way to use it is to anoint the body from neck

to knees. Local application seems only to cause the lice to migrate to those parts of the body not treated.

Crude Oil Ointment.—The materials at hand permitted only a somewhat crude preparation: 2 lb. of soft paraffin was melted and 4 oz. of crude tar oil added. The mixture set like an ointment. Used like Vermijelli, it showed a very much higher killing efficiency than that preparation, and a slightly higher general efficiency. As a deterrent it was subjected to the same test mentioned under N.C.I. and gave a result of 97.7 per cent. efficiency.

N.C.I. and Vermijelli.—The ointment was smeared at the fork of the trousers and the seams, the N.C.I. being dusted down the shirt and trousers. The killing efficiency of N.C.I. was increased slightly, but the general efficiency was increased highly.

The report received from the medical officer of one infantry unit which used the preparations in the trenches is convincing. The preparations were efficient from three to seven days. After about the third day it was found that young lice appeared, obviously from eggs on the clothing. Periodic treatment is therefore necessary. There was a great demand for more.

N.C.I. and Crude Ointment.—Used as above, the results were very similar.

Mercury Ointment (variously termed blue unction, blue ointment, and navvies' butter).—To prevent undue absorption of mercury into the skin equal quantities of the ointment and soft paraffin were mixed. The killing and general efficiencies were both high when the ointment was used like Vermijelli. It is feared, however, that the nature of the preparation precludes that consistent use which present conditions demand. To verify its effect as a deterrent, a similar test as in N.C.I., but employing only 300 lice, was carried on in accordance with a well-known treatment. Strands of tape, well smeared with the ointment, were fastened round the ankles, knees, waist, arms, and neck. The precautions proved utterly useless. The lice simply swarmed over the body. After a somewhat unhappy two hours, and to secure rest, the body was smeared all over. Yet next morning 35 live lice were found on the body and clothing.

White Mercury Powder.—This preparation had very low killing and general efficiencies.

Sulphur.—Three experiments, one personal, were performed. In one case, an ointment, half flowers of sulphur and half soft paraffin, and in two cases a generous amount of flowers of sulphur, were used. They proved such complete failures that it is not proposed to pursue further experiments with these substances.

Treatment of Infested Underclothing.

The following notes are the result of many experiments carried on under the everyday working conditions at the divisional baths, treating clothing in quantity in large cauldrons, tubs, and disinfectors.

Thresh Disinfectors.—For the horse-drawn "Thresh" it was found best that not more than one hundred garments should be steamed at 215° F. for three-quarters of an hour. For the Foden lorry "Thresh" one hundred garments per chamber should be steamed at 220° F. and 5 lb. pressure for half an hour.

Boiling Water.—When shirts have been boiled five minutes in water, lice are killed, and the eggs become white and opaque, owing to the coagulation of the protoplasm. As a check, eggs at different parts of the shirts were incubated on the body for fourteen days. None hatched. Since writing the above it has been ascertained that Mr. Bacot, Entomologist to the Lister Institute, working on a small scale with small numbers of eggs and test tubes, found that boiling for one and a half minutes was sufficient to kill the eggs.

Cresol Solution, 1½ per cent. cold.—This solution is bactericidal strength. It was found, after *thoroughly* soaking infested shirts for one hour, that the lice were killed. Patches holding eggs were rinsed in cold water to get rid of the cresol and the eggs incubated on the body. After thirteen days no eggs hatched.

Chloride of Lime, 7 per cent. cold solution, used for twenty-four hours is effective, but alum, 10 per cent. cold solution, used for forty-eight hours, was a total failure.

Divisional Baths.

Apart from laundry work, the main object of the baths is to turn large numbers of infested men into clean men as quickly as possible. The three processes are the bathing, the issue of clean underclothing, and the disinfection of the outer garments. The first two are easily carried out, but the last presents many difficulties. Without it the results of bathing and changing are of little value. Treatment by steam or gas disinfection takes too long, as it is usually necessary for men to pass through the baths in a quarter of an hour. Ironing with a hot iron is the most practicable scheme. This is a slow process, but one of cardinal importance, *because it determines the rate of bathing.* A bathing party being dealt with in a quarter of an hour, the time taken to iron the tunic, trousers, and cardigan jacket of each man being ten or twelve minutes, the number of ironers must equal the number of bathers per quarter of an hour. For example:

Strength of division	19,200
Rate of bathing	1 in 15 days.
Number of men passed through per day... ...	1,280
Number of men passed through per hour (8 hours' bathing per day)	160
Number of men passed through per quarter of an hour	40
Number of ironers required	40

Other considerations that may arise are: This bathing procedure, carried on regularly, will in time reduce the degree of infestation so that the less ironing will be necessary; as local conditions at certain times cause the baths to lie idle, it will be necessary to have other activities to hand, such as laundry or mending work, for the ironers.

RECOMMENDATIONS.

The main object of this section is to suggest an outline for a plan of campaign against the pest.

Research Centre.

The scope of this subject and the virulence of the pest make it necessary that one centre of research be established under a specialist in each army. The apparatus required is really very simple and small in amount. Assistants are necessary for laboratory and outside work.

Advisory work could also be carried on as each unit is frequently a special case. Facilities for transport should also be afforded.

Instructional Work.

At these centres instruction could be pursued by three methods—

1. *Classes*, similar to those carried on for other military affairs, could be initiated for such N.C.O.'s and men (pioneer, sanitary, or R.A.M.C.) as units may specially set apart for dealing with lice.

2. *Lectures and demonstrations* to military units could be arranged, each unit being represented by officers, medical officers, N.C.O.'s, sanitary men, stretcher-bearers, and men in such numbers as may be convenient. A suitable time is when regiments are resting for a period longer than a week. The aims are the presentation of the true facts with regard to the pest, recommendations for dealing with it, and, most important, *to foster the idea that it is not by any means impossible to bring the parasite under.*

3. *Issue of Leaflet.*—A short leaflet embodying the following could be printed and distributed to all ranks—

Campaign against Lice.

It is not correct to think that lousiness cannot be reduced to a minimum. Experiments, in detail and on a large scale, carried on among soldiers in billets and trenches go to prove (1) that the soldier himself is the main source of infestation, (2) that the measures suggested below are of great benefit.

1. Whenever possible, and as regularly as possible, search the clothing thoroughly for both lice and the "nits" or eggs. If you have discovered that the removal of the white patch which binds the seams at the fork of the trousers does not interfere with comfort, it is well to remove the patch. Special care during searching for the lice and eggs should be paid to this region.

2. The great source of danger is the presence of eggs on the clothing. These hatch in about a week. It is necessary therefore that the trousers should be ironed and brushed at least once a week. While in the trenches it is often quite possible without undressing to use a piece of hot metal or a tinder lighter. This removes the source of danger upon yourself.

3. Against the lice themselves, whenever you find it necessary, use the remedies recommended. Powders, as a rule, should not be used at the fork, but down the shirt and trousers. Care should be taken to see that any powder which falls from the shirt to the fork should be small in amount, as too much is

liable to cause smarting. If your stock of ointment and powder is exhausted, apply to the man in your unit who is responsible for the distribution of these preparations.

4. Just previous to going to the trenches be careful to treat the clothing and body as directed.

5. Use the preparations about every four days. Experiments in the trenches have shown this to give the best results.

6. See that any material, blankets, empty sandbags, etc., which may be present to increase the comfort of the dug-out or billet, are treated with the powder preparation.

7. *Take advantage of all the facilities offered at the baths.*

Divisional Baths.

1. Each division should be provided with two baths, each capable of dealing with eighty bathers per hour, and two Foden lorry Thresh disinfectors.

2. Baths should be built, and not improvised (except in specially favourable circumstances) from permanent buildings. The design of the building should be such that contamination is impossible.

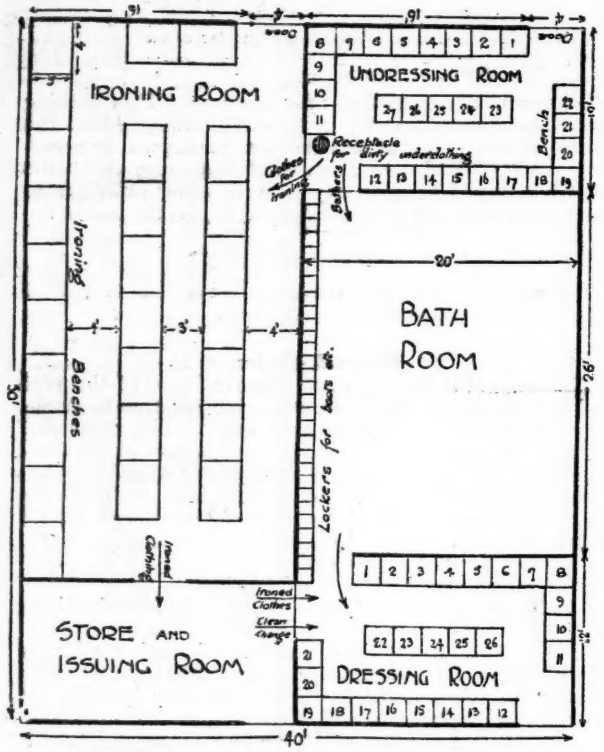

Fig. 10.—Suggestion for a Divisional Bath (from one now working at the front.)

3. *Procedure for Bathing.*—Man strips in undressing room, outer clothing handed in or collected for ironing; then enters bathroom, and baths; enters dressing-room, and given clean change of underclothing, uses insecticide, receives ironed clothing, and dresses.

4. *Treatment of Underclothing.*—Laundry work may possibly be carried on with advantage at one centre, and not at each bath.

A. *Garments Disinfected in Thresh Apparatus.*—Three-quarters of an hour at 215° F., in horse-drawn type; half an hour at 220° F., and 5 lb. pressure in the Foden lorry type; washed; dried; folded; stored.

B. *Cresol Solution, Auxiliary Method, Suitable for Detached Units.*—Steep garments *thoroughly* for two hours or more in solution (1 pint of cresol to 8 gallons of cold water); rinse to rid of surplus cresol; wash, etc., in usual way.

C. *Boiling Water, Auxiliary Method, Suitable for Detached Units.*—Allow garments to soak thoroughly and *remain in boiling soapy water for five minutes;* remove, and wash, etc., in usual way.

5. *Treatment of Outer Clothing.*—Clothing collected (tunics, trousers, and cardigans), ironed with hot iron, particularly at seams and forks of trousers; brushed with a hard brush; distributed to men in dressing-room.

For the Trenches.

While a unit occupies a trench it should be the duty of a man set apart for the work to see that an adequate supply of insecticides is available for distribution to the men, and for general use in the dug-outs. Company officers should see that their men take the necessary precautions against the pest.

For Billets.

This applies particularly to infantry in the rest areas and to isolated units, such as ammunition columns and infantry transport:

1. Men should be afforded set times for the express purpose of inspecting their clothes.

2. A general inspection by the company officer or medical officer is recommended at least once a week, but men of known unclean habits require special attention, if only for the sake of their comrades.

3. A keen look-out for cases acting as bad lice-carriers should be maintained and such men dealt with speedily.

4. In addition to existing methods for maintaining clean billets, all old clothing should be removed. Floors and skirting boards should be washed with soapy water to which has been added crude oil and cresol.

5. If bathing and changing facilities do not exist, the ironing of garments should still be attempted.

For Hospitals.

These remarks apply particularly to hospitals and rest stations carried on by field ambulances, where conditions are frequently difficult.

Even if patients are retained for one night some measures should be employed. When possible a patient should bathe, have a change of underclothing, and have the outer garments ironed.

None of these recommendations are difficult in themselves. The real difficulties are in the regular and persistent use of the methods during exceptional and trying circumstances. For troops living in billets and hospitals the work is feasible, but for infantrymen matters are more difficult. It is necessary, however, to emphasize that the most effective measures may be carried on while men are out of the trenches. In the trenches the work necessary is reduced to the regular distribution and use of insecticides.

To conclude, the matters of cardinal importance are, first, that a definite plan of campaign be formulated, and secondly, that the plan be followed up vigorously by the work of proficient men. It is not so much a problem of pure science as one of common sense management.

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NOTES ON PEDICULUS HUMANUS (VESTIMENTI) AND PEDICULUS CAPITIS.*

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Body lice, *Pediculus humanus* (*vestimenti*), and head lice, *P. capitis*, were reared and kept confined in small entomological glass-bottomed boxes, the lids being removed and fine silk gauze (chiffon) stretched across the open ends in their place. The insects fed readily through the gauze when this was placed against the skin. Boxes containing the lice were carried in waistcoat pockets during the day, and placed beneath a belt against the body during the night. The insects had therefore approximately from six to seven hours daily during which they could feed. In one experiment opportunities of feeding during the day were also afforded them, with the result that egg production was increased. The totals and averages of the eggs laid must be taken only as a comparative guide to fertility; in nature, or under more favourable conditions, the numbers would probably be exceeded. It is probable that the conditions were better suited to the body than to the head louse.

Pediculus humanus is larger, more robust, and less active than *P. capitis;* the females having a relatively

* Abstract of a paper in course of publication in the *Journal of Hygiene.*

greater egg-carrying capacity than those of the head louse. The eggs are slightly larger and the number laid was greater, while the habits associated with egg-laying differ, although by transposing the conditions suitable for other species a considerable degree of uniformity may be produced. It is probable that in nature their egg-laying habits are quite distinct.

Cross pairings between the insects are easily brought about and might, under exceptional circumstances, occur naturally. Hybrid strains resulting from pairings of *P. capitis* males with *P. humanus* females, and *vice versa*, were maintained without trouble until the F_3 generation, and there seemed no reason why such strains could not be continued indefinitely. Nevertheless, the marked disparity in the sexes of the F_1 generation of some crosses between *P. capitis* male and *P. humanus* female was suggestive of the specific rather than the racial rank of the two insects.

The mortality of females of *P. capitis* crossed with *P. humanus* males points in the same direction, but there was no such obvious disparity in the sexes of the first generation of hybrids from this cross, nor was there any marked disparity in the proportion of the sexes in the following hybrid generations.

In size the hybrid insects are approximately intermediate, but inclining in form, activity and habits towards *P. capitis*. Extreme disparity in the size of some individuals of either sex was noted in some of the broods of the F_3 generation; very large males and small females being observed.

Habits.

The body louse exhibits habits of gregariousness, especially during the moulting phases, and a preference for retiring to a particular spot to oviposit, which leads to the clustering of eggs; both of these habits are shown, though in a less marked degree, by *P. capitis*, and it is possible that they might be partly due to the conditions of captivity, though it seems more probable that the divergence in its habitat is accentuating both tendencies in *P. humanus*.

Pairing with both species took place at any hour, and was very frequently observed when the insects were examined after feeding; males with but little food in the alimentary tract were, however, often seen in coitus. The period during which the insects remained together was on several occasions noted to exceed an hour, but no limit of time was determined.

A male of *P. humanus* fertilized 18 out of 21 females placed with him in succession. Attempts with *P. capitis* were less successful; out of four trials one male fertilized 10 females, and might possibly have equalled the record of *P. humanus* but for the scarcity of virgin females while the experiment was in progress.

Eggs are laid by virgin females of both species on the second or third day following the final ecdysis, and continue to be freely laid so long as feeding continues and the body conditions of temperature prevail, but these unfertilized eggs do not hatch. The longest period for which a female *P. humanus* retained the power to lay fertilized eggs after the removal of the male was twenty days; more usually it would seem to be from sixteen to eighteen days. In the case of *P. capitis* the period was considerably shorter, twelve days being the longest ascertained period, while it was usually about seven to eleven days.

The greatest number of eggs laid by any one female of *P. humanus* was 295—an average of 6.4 per day; the daily average of a number of females being 5.1. Females of *P. capitis* showed a lower fecundity—the highest record being 141, with a daily average of 4 per day; the average of a number of females being 3.7 daily. These figures would probably be exceeded under natural conditions. An experiment in which some females of *P. humanus* were given an opportunity to feed for two hours by day in addition to seven hours each night, showed unmistakably the extent to which egg production was dependent upon food—the average of these females rising to eight per day. The fertility of the eggs laid was unaffected by the increased feeding. The greatest number of fertilized eggs laid by a female *P. humanus* after the removal of the male was 115; with a female of *P. capitis* the parallel figure was 70.

Length of Life.

The life of the male *P. humanus* which fertilized 18 females was 32 days after reaching maturity, while the longest female life after maturity was 46 days—the average of a number of females being 34 days. With *P. capitis* the figures were: Male life 30 days; female life 38 days—the average of a number of females being 27 days. The lives of the hybrid insects were not noticeably shorter than those of *P. humanus* and the hybrids seemed to breed more freely than *P. capitis*.

Tests made with unfed *P. humanus* showed that the longest lives were at a medium temperature of 60° to 65° F.; many of the insects living from 3 to 4 days, while two lived 5, and one 7 days. At 76° F. all died within 5 days, and at 98° F. all died within 3 days.

Newly-hatched larvae, unless fed, lived less than 24 hours at 98° F., and if kept in a box in the vest pocket they lived but little more than a day, unless fed; none survived a second day.

Adults kept in a box in an outer pocket of a walking coat during March lived five days without food.

Of forty young lice which emerged from the egg on the same day the following record of the moulting periods was made:

First Moult.			*Second Moult.*		
3 per cent.	on the	3rd day	15 per cent.	on the	7th day
42 ,,	,,	4th ,,	72 ,,	,,	8th ,,
55 ,,	,,	5th ,,	13 ,,	,,	9th ,,

Third Moult.					
5 per cent.	on the	10th day	...	...	mature
3 ,,	,,	11th ,,	...	...	,,
55 ,,	,,	12th ,,	...	...	,,
32 ,,	,,	13th ,,	...	...	,,
5 ,,	,,	14th ,,	...	...	,,

Cold.

Active specimens of *P. humanus* survived two days at a temperature of 28° F. to 30° F., but none after exposure to these conditions for a week.

Hatching of Eggs.

Under humid conditions in an incubator kept at 87° F.—

3 per cent.	of the	1,300 eggs	tested	hatched	on the	7th day
56	,,	,,	,,	,,	,,	8th ,,
33	,,	,,	,,	,,	,,	9th ,,
8	,,	,,	,,	,,	,,	10th ,,
0.2	,,	,,	,,	,,	,,	11th ,,

A test carried out with eggs taken from a stock box—date of laying uncertain, some having been laid possibly as many as three days previously—showed that none hatched at 60° to 65° F., while at 76° F. there was considerable mortality in the egg stage. The hatching period of those that survived was spread over a longer period than usual. At 98° F. the period of hatching only covered five days, while the mortality was not excessive.

To give some idea of the possible rate of multiplication of *P. humanus*, we may estimate the egg period as twelve days and a further twelve days to the maturity of the females. Allowing an average of eight eggs per day, spread over a fertility period of forty days, we find that during her life a single female may have 4,160 offspring.

AN INVESTIGATION OF THE BEST METHODS OF DESTROYING LICE AND OTHER BODY VERMIN.

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II.

In a preliminary communication[1] to the BRITISH MEDICAL JOURNAL I described some early experiments in breeding lice, which showed that the humidity of the atmosphere was of importance—a fact which I have since ascertained to have been previously discovered by Mr. Bacot, of the Lister Institute, with regard to the breeding of fleas.[2]

Up to the present I have been unable to determine the constant conditions that would enable lice to breed and live in the incubator, the lice being removed from the incubator only while feeding on the human body. On one occasion, out of some forty experiments with different samples of lice, it was found possible to keep the lice alive and to hatch out their eggs when they were suspended over water by means of a cotton-wool plug

inserted midway in a glass tube kept at body temperature in the incubator, but failure to repeat this result suggests that perhaps some other factor at present unknown is essential to secure the requisite constant conditions.

It has therefore been necessary for the purpose of insecticidal experiments with lice to take them from verminous clothing and expose them directly to the insecticidal agents. To this end a supply of verminous clothing was obtained about twice weekly from military barracks, and from lodging-houses, and the Poor Law institution.

The variation in resistance of lice as found in nature is very great, and it therefore seemed well in all the insecticidal experiments already reported to pass over experiments where death to the louse resulted, if in a similar experiment with another strain of lice an occasional louse appeared to survive. In some recent experiments undertaken for the purpose of testing earlier results I have not found any of the lice to show unquestionable evidence of life after exposure to boiling water even for five seconds. It would therefore appear that in my earlier series of experiments I had been misled in interpreting certain movements as a sign of life, the more that so competent an authority as Mr. Bacot[3] has in a recent contribution on the subject stated that he invariably obtained a lethal result. Mr. Bacot, in his interesting and valuable paper, has described a method for breeding and rearing lice in contact with the human body. He found that lice thus reared never survived thirty seconds' immersion in boiling water, and that a temperature of 55° C. (131° F.) maintained for half an hour killed both active lice and their eggs.

Volatile Oils and Phenol Bodies.

I have made some additional tests with oil of cloves and oil of turpentine. I have also experimented with oil of bergamot. I have found that when immersed in oil of cloves for two minutes and then placed on a piece of blotting paper, the lice move freely over the paper. After similar immersion in oil of bergamot only an occasional louse moves, and the movements are feeble. After immersion for the same time in oil of turpentine all the lice are dead. But how far the movements noted are compatible with the ultimate survival of any of the lice has not been determined.

I have also made further tests with the phenol bodies, and in consonance with my former experiments I have repeatedly found a varying proportion of the lice survive half an hour's immersion in a 5 per cent. emulsion of cyllin in water at ordinary room temperature.

Insecticidal Powders.

During the past year I have received several letters from officers of the R.A.M.C., who have indicated that in endeavouring to keep soldiers free from vermin infection much trouble has been occasioned by the rapidity with which a unit once cleansed has been reinfected. It appears that a lice-free unit is generally infected from barns and trenches previously occupied by lice-infected units. In order, therefore, to secure immunity from lice infection, means are required for keeping the clothes and body constantly obnoxious to lice.

I have investigated several insecticidal powders in the hope that one might be found which, when applied to the clothing, would secure the desired result. I first tested the antiparasitic powder described by Mr. Langford Moore[4]; it has been largely used, and has gained a considerable reputation as an insecticide. It consists of

Ammoniated mercury	1 oz.
Zinc oxide..	½ oz.
Magnesium silicate	½ oz.

Mr. Moore believes that the zinc oxide, by its astringent and dehydrating effect, inhibits absorption of the slowly ionized mercurial salt, and thus prevents toxic action. The magnesium silicate (or French chalk) is added to increase the diffusibility of the powder on application. I have repeatedly found that lice in contact with this powder at body temperature and humidity remain alive and apparently unaffected after twelve hours—the period of the experiments—and that if suspended over the powder they remain altogether unaffected. It may be that the powder is obnoxious to lice in an indirect manner or when ionization of the mercurial salt has proceeded further, but I have failed to secure the suitable experimental conditions.

In a similar manner I have tested several powders of unknown composition sold as insecticidal powders for soldiers, and have failed to observe any marked insecticidal effect.

I have made some experiments with freshly ground Dalmatian insect powder (*Pyrethrum cinerariaefolium*). When used at once in the fresh condition it has a definite insecticidal action, commonly killing all lice immersed in it in a period of two hours. The insecticidal value of the powder becomes gradually diminished when it is exposed to the air; after two days' exposure it failed to kill lice even when left in contact with it for several hours.

Naphthalene.

The powder known as N.C.I. powder is being largely used in the army. I have learnt since my experiments with it were completed that it was originally prepared under the direction of a member of the staff of the Royal Army Medical College, Millbank, but I have ascertained from the college that no experiments have so far been published. This powder is being supplied by the South Metropolitan Gas Company, and the chemist of the company has informed me that the N.C.I. powder consists of

Naphthalene...	96 per cent.
Creosote	2 ,,
Iodoform	2 ,,

I conducted test tube experiments with the powder in two series. In one lice were immersed in the powder, and all were killed within five minutes; usually two minutes were sufficient. In the second series the lice were separated from the powder by cotton-wool, and were exposed only to the vapour from the powder. Here the extreme length of time required for the killing of the lice was about thirty minutes, but in some of the tests the lice were killed in about fifteen minutes. To ascertain the effect of the powder when applied to the human body, pieces of cloth, such as is employed for underwear, were dusted with it and were used for loosely covering lice applied to a portion of the skin for varying periods of time. It was found that the lice were killed within one hour, but that many died within a quarter of an hour. The powder showed no irritant effect, even after application for a period of eight hours. Three series of experiments were made to test the values of naphthalene, creosote, and iodoform separately as insecticides, with the following result:

1. *Naphthalene.*—Specimens of pure naphthalene and of commercial naphthalene were used, and it was found that while lice in contact with freshly powdered pure naphthalene commonly died in one hour, lice in contact with freshly powdered commercial naphthalene usually died in half an hour. These experiments appear to show that the lethal power of naphthalene for lice is dependent in great part on the presence of hydrocarbons and coal-tar derivatives other than pure naphthalene.

2. *Creosote.*—It was found that immersion in fluid creosote for one minute commonly killed lice, but on a rare occasion a louse could be revived. So far it has not been possible to revive any louse after immersion for two minutes. Lice exposed to the vapour of creosote were usually killed in twenty minutes, and no louse was found to survive at body temperature for more than thirty minutes.

3. *Iodoform.*—It was found repeatedly that lice in contact with iodoform, even when buried in it, remained alive for eight hours, but were usually killed after twelve hours. Over the vapour of iodoform lice lived practically unaffected for several days.

It would appear, then, that of the three constituents of N.C.I. powder, naphthalene and creosote have each a strong and iodoform only a very feeble insecticidal action. But before iodoform could be regarded as a somewhat useless constituent of N.C.I. powder it was necessary to be certain that its presence did not markedly modify the action of the powder. To determine this, two powders were prepared, one being the ordinary N.C.I. powder, the other differing only in that it contained no iodoform. In a series of test tube experiments in which lice were suspended over the powders or placed in contact with them it was found that the lethal period was the same for both powders.

Experiments were now made with these powders on the human body, pieces of clothing being dusted with the powder and used for covering lice previously placed on the forearm. It was found that the N.C.I. powder adhered much better to the clothing than did the powder without

the iodoform, and that while the N.C.I. powder commonly killed the lice in half an hour, the N.C. powder required an hour.

In order to determine whether the superiority of the N.C.I. powder depended mainly on its greater adhesiveness for cloth and not on the presence of iodoform, a powder was prepared that differed from N.C.I. powder only in that insecticidally inert magnesium silicate was substituted for iodoform. A comparison of this powder with the N.C.I. powder showed that for practical purposes the action of the two powders was identical.

In a fairly large series of these experiments I have been left with the impression that the N.C.I. powder is very slightly more effective than the naphthalene, creosote, and magnesium silicate powder, and this was to be expected, since iodoform has a slight insecticidal action, while magnesium silicate has no such action. Both powders contain naphthalene and creosote, and, since the price of iodoform at the present time is 25s. 6d. per pound, and the price of magnesium silicate is 4s. 6d., it would appear that the efficiency of the N.C.I. powder would not suffer in any material degree if magnesium silicate were substituted for iodoform.

A solid substance capable of being powdered and of being applied without harm to the human body must be an essential basis of an insecticidal powder. Of all the solid substances I have examined naphthalene is the most actively insecticidal. It would have been of interest to have investigated the toxic effects on man and lice of the solid perchlorethane on account of the high insecticidal value of the chlorine derivatives of ethane. Perchlorethane is a crystalline body with a camphor-like odour, but, so far, I have been unable to obtain a supply of this substance. Theoretically, it is not essential that the solid basis of the powder should be actively insecticidal, provided that it is possible to incorporate actively insecticidal agents with it. In a series of experiments powders were prepared, with magnesium silicate as a basis, and containing various actively insecticidal liquids, such as trichlorethylene and creosote, and were compared with powders containing similar liquids, but with naphthalene as the basis. In every case the greater efficiency of naphthalene as a basis for the powders was substantiated.

Experiments were made for the purpose of ascertaining whether the creosote in the N.C.I. powder could be advantageously replaced by another insecticide. In my early experiments I had found that the liquid preparations most lethal to lice are certain chlorine derivatives of ethylene and ethane. Recently also I have investigated the insecticidal value of anisol (methyl phenyl ether), which appears to enjoy some reputation for this purpose. In a series of comparative experiments with these insecticides and with creosote I have ascertained that trichlorethylene commonly kills lice by immersion in a few seconds, and invariably kills them within thirty seconds. Immersion experiments with tetrachlorethane, pentachlorethane, anisol, and creosote showed that they usually kill lice in one minute, and that no louse survives immersion for two minutes. It is difficult to place these four substances in order of insecticidal activity, so nearly do they agree and so variable is the resistance of the occasional louse, but the experiments showed that tetrachlorethane was slightly more active than creosote, and there can be no doubt as to trichlorethylene being much more active.

The different insecticides were each separately incorporated with commercial naphthalene in the two proportions of 2 per cent. and of 5 per cent., which was found to be the limit within which naphthalene could conveniently hold the liquids without ceasing to be pulverulent. In a series of experiments with freshly-prepared powders the trichlorethylene powder easily maintained its advantage, commonly killing by contact all lice within a few seconds, while the tetrachlorethane, pentachlorethane, anisol, and creosote powders usually required two to three minutes. But when the powders had been exposed in the open air for some time the results were different. The trichlorethylene powder, when thus exposed for even a few minutes, rapidly deteriorated, and after fifteen minutes' exposure its action on lice corresponded to that of naphthalene alone. On the other hand, the other preparations, initially interior to the trichlorethylene powder were found, even after exposure to air for a period of one to three days, to have an insecticidal activity superior to that of naphthalene alone.

Paraffin Bodies.

In experiments with the volatile paraffin bodies, such as petrol and royal daylight oil, it was found that petrol ordinarily killed lice by immersion in one minute and invariably in two minutes, while the ordinary illuminant oils commonly killed in two minutes and invariably in five minutes. When these substances were severally incorporated with naphthalene in 2 and 5 per cent. proportions, as in the other experiments, it was found that even with the freshly prepared petrol powder no insecticidal action greater than that of naphthalene could be definitely determined, and that with the illuminant oil powders the insecticidal action of naphthalene was only slightly increased.

The explanation of these results appears to depend on the rate at which the incorporated liquid is volatilized. The enormous surface provided by the powdered naphthalene must greatly accelerate the evaporation of the added volatile fluid. The rate of evaporation of the several liquids was roughly tested.

Equal weights of each of the liquids were exposed to the air in wide-mouthed bottles of equal calibre for a period of sixteen hours at the body temperature, and the loss of weight noted. Petrol and trichlorethylene were found to evaporate much more rapidly than any of the other substances, and petrol more rapidly than trichlorethylene. Then next in order came tetrachlorethane, royal daylight oil, pentachlorethane, anisol, and, finally, creosote with the lowest vapour pressure of the series.

Creosote would therefore appear, when all conditions are taken into account, to be the most valuable of the actively insecticidal liquids for admixture with naphthalene in an insecticidal powder. When mixed with naphthalene the immediate lethal effect of creosote is less than that of the trichlorethylene powder, but the much longer period during which creosote continues to exert its action more than compensates for this initial disadvantage.

N.C.I. powder has been objected to on account of its moist condition. The chemist of the company supplying the powder has informed me that the use of liquid creosote renders the powder apt to clog in the perforated tins in which it is supplied, and that it has been suggested that the creosote might be replaced by pure phenol. I have not been able to satisfy myself that the substitution of phenol for creosote makes any practical difference to the dryness of the powder, and tests made with the phenol powder on various individuals show that the skin in not a few instances is distinctly irritated by the phenol.

I have made some experiments to determine if the N.C.I. powder could be made drier, and therefore more easily dusted, by some variation in its composition and yet retain its efficiency. In some experiments such efflorescent salts as disodium hydrogen phosphate, sodium sulphate and sodium carbonate were added in turn to the extent of 5 per cent. to N.C.I. powder; when these preparations were kept in sealed bottles the various efflorescent salts exerted no drying effect of practical importance, every preparation tending to cake and adhere to the bottle. In this condition the powders were found to retain their insecticidal activity unimpaired. When, however, the powders in these experiments were exposed to the open air drying occurred in from one to two days, and the powders became very suitable for application through perforated tins. But on testing the insecticidal properties of the dried powders, it was found that their values had greatly deteriorated, and that in a well-dried powder lice could live for hours apparently unaffected. It would appear that the coal-tar products on which the insecticidal effect mainly depends are volatilized. So far it seems impossible to dry a naphthalene-creosote powder and at the same time retain the efficient moist and volatile hydrocarbons and other coal-tar derivatives.

In perforated tins any naphthalene-creosote powder must gradually lose its insecticidal properties, and the moist nature of the powder precludes it being used successfully in these tins. It would therefore appear to be desirable that naphthalene-creosote powders, such as N.C.I. powder and naphthalene, creosote and magnesium silicate powder should be supplied in sealed tins of small size. I believe that the application of such powders twice weekly

to clothing would destroy any lice that might be present, and would practically keep the persons lice-free.

Gases.

Experiments have been made in which verminous clothing was exposed to chlorine, formaldehyde, and sulphur dioxide. In one series articles of clothing infested with lice were placed for one hour in air heavily charged with each of the gases. It was found that chlorine had least effect. Some of the lice on the surface of the clothing were killed, many of them were stupefied, but many remained active. Formaldehyde stupefied all the lice on the surface of the clothing, but many afterwards revived; lice protected by folds of clothing remained active. Sulphur dioxide killed all lice on the surface of the clothing, but only stupefied lice protected from the gas by folds of clothing. Many of such lice afterwards revived. In some experiments where articles of clothing infested with lice were placed in rooms and exposed for twelve hours to these gases as ordinarily employed for disinfecting purposes a somewhat similar result was obtained.

A few experiments similar to those described by Blacklock[5] when investigating the resistance of the bedbug to gases were made to determine directly the insecticidal action of sulphur dioxide. When lice were placed in a two-way glass tube through which sulphur dioxide was passed from a pressure bottle, they were killed in a few seconds, and no louse survived five seconds. In another experiment the gas was poured into a deep vessel and the lice dropped into it. Here also the lice were all dead within five seconds. Lice wrapped in cotton-wool and dropped into the jar were all dead after one minute, but when wrapped in pieces of clothing and dropped into the gas an occasional louse was found living after one minute, but none survived after two minutes.

Sulphur dioxide has, therefore, in these experiments maintained its reputation as the most efficient gaseous insecticide, but as ordinarily used for disinfecting purposes it cannot, owing to lack of power of penetration, be depended on to kill all lice in verminous clothing.

Emergency Cleansing of Clothing by means of Petrol.

In a letter to the BRITISH MEDICAL JOURNAL of June 26th, 1915, Dr. Davison, Monkseaton, Northumberland, indicated that in some cases it would be of value to medical officers responsible for the cleansing of soldiers if a safe and economical method for cleansing an occasional verminous kit by means of petrol might be devised without having recourse to the installation of an elaborate dry cleaning apparatus. It is obvious that any such method to be practical must be free from the general danger of fire and from possible damage to clothing as a result of excessive heat. It was necessary, then, to devise a method of vaporizing petrol without danger from fire so that it could be applied in emergency on active service or for the occasional verminous kit at home. In experimenting with various substances, such as boiling water and red-hot iron, as sources of heat, I found that a stone heated in the fire to a dull red heat and then transferred directly into a basin of petrol is the best means of securing the evaporation of petrol with safety. I arranged a box roughly divided into a lower and upper compartment by means of a wire screen. The verminous garments were placed in the upper compartment and the box closed. A door at the side gave access to the lower compartment, containing a basin of petrol into which a hot stone was introduced. The evaporation of the petrol proceeded rapidly, but it was found that the petrol immediately condensed on the nearest cold surfaces. Thus the lower layer of clothing was moistened with petrol, and the lice there were killed, but no penetration occurred and many lice survived. To secure the insecticidal action of the vapour of petrol a regulated oven would have to be employed, and this is costly and not available for emergency purposes.

It would appear, then, that for the purposes indicated immersion of verminous clothing in petrol remains the most suitable method. Danger from fire would be diminished by using a petrol soak tank with a well-fitting lid, but the danger in wringing and removing the garments would remain. Such a tank could be placed in an open shed, apart from any building, and the petrol-treated clothing exposed to the outside air would dry within an hour. Similarly, an enclosed rotary hand washing machine, costing about £4 4s., might be employed for the purpose, and this would also permit of the clothing being dry-cleaned.

Recently a further problem in the control of lice has arisen in towns where rest houses have been provided for soldiers delayed by train connexions or otherwise while travelling home on leave from France. In many cases the soldier remains in the town for too short a time to permit of efficient cleansing of himself and his kit, and until it is found convenient to cleanse all soldiers granted leave the use of an actively insecticidal powder in these houses is the best method.

Cleansing of Verminous Heads.

The superior value of the chlorine derivatives of ethylene and ethane as destroyers of lice, and their non-inflammable properties, as previously recorded, led me to suggest that these bodies might be employed with advantage in the cleansing of verminous heads, and I suggested that they might be employed as soap preparations and in vaseline pomades. Recent experience in hospital has indicated that nurses were averse to shampooing verminous heads, and has led to tests being made with these chlorine derivatives undiluted. The effect of trichlorethylene when applied freely to the scalp is variable. Little discomfort seems to be produced in some cases, but severe—though transient—pain results in others. In similar tests it was found that tetrachlorethane is usually free from severe irritant action. One consideration was the danger that these bodies when applied to the hair might accidentally reach and injure the eyes. It has been found in practice in hospital that the desired result is obtained when the hair is gone over carefully with pieces of cotton-wool moistened with either trichlorethylene or tetrachlorethane, and irritant effects to the scalp and eyes are obviated. In the great majority of cases one application has been sufficient to destroy all lice and nits, and rarely have more than two applications been required. Tetrachlorethane, although less powerful than trichlorethylene, is very actively insecticidal, and may be preferred to trichlorethylene on account of its less irritant properties, and this is of importance in dealing with verminous heads on which skin is broken.

Conclusions.

1. As Mr. Bacot has shown, and as my later experiments also demonstrate, lice do not survive immersion in boiling water.

2. Several insecticidal powders have been tested, and of these N.C.I. powder is the most destructive to lice.

3. Of the three constituents of N.C.I. powder, naphthalene and creosote have each a strong insecticidal action. The insecticidal action of iodoform is feeble.

4. Naphthalene appears, so far as my comparative tests have gone, to be the most suitable basis for use in the preparation of a powder destructive to lice. Commercial naphthalene is more actively insecticidal than pure naphthalene, and it appears that the lethal power of naphthalene for lice is dependent in great part on the presence of hydrocarbons and coal-tar derivatives other than pure naphthalene.

5. The immediate lethal effect of creosote when mixed with naphthalene is less than that of some other insecticidal liquids, but the longer period during which creosote continues to act more than compensates for the initial disadvantage.

6. In addition to its feeble insecticidal activity, iodoform greatly increases the adhesiveness of N.C.I. powder for cloth. The inclusion of iodoform in the powder is accordingly justified, although similar adhesiveness of the powder is obtainable at less cost by substituting the insecticidally inert but cheaper magnesium silicate for iodoform in the powder.

7. The insecticidal power of naphthalene-creosote powders gradually diminishes when they are exposed in the open air.

8. The moist nature of such powders precludes their being used successfully in perforated tins, and it has not been possible to dry the powders and at the same time retain the moist and volatile hydrocarbons and other coal-tar derivatives on which the insecticidal effect mainly depends.

9. It is desirable that naphthalene-creosote powders should be supplied in sealed tins of a uniformly small size, or of sizes suitable for the immediate requirements of a convenient number of persons proposed to be treated at one time.

10. In experiments with gases, sulphur dioxide has maintained its reputation as the most efficient gaseous insecticide, and all lice exposed to an atmosphere of the gas die within five seconds. As ordinarily used for disinfecting purposes and as a result of lack of penetration sulphur dioxide cannot be depended on to kill all lice in verminous clothing.

11. For the emergency cleansing of clothing by means of petrol, immersion of the verminous clothing in petrol remains the most suitable method. To secure the insecticidal action of the vapour of petrol a regulated oven would have to be employed.

12. The superior value of certain chlorine derivatives of ethylene and ethane as insecticides and their non-inflammable properties indicate their use in the cleansing of verminous heads. The desired result is obtained and irritant effect on the scalp is obviated when the hair is gone over carefully with pieces of cotton-wool moistened with either trichlorethylene or tetrachlorethane. Tetrachlorethane, although less powerful than trichlorethylene, is very actively insecticidal, and is to be preferred to trichlorethylene on account of its less irritant properties.

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MEMORANDUM ON THE TREATMENT OF INFECTED WOUNDS BY PHYSIOLOGICAL METHODS.

(Drainage of Infected Tissues by Hypertonic Salt Solution, and Utilization of the Antibacterial Powers of the Blood Fluids and White Blood Corpuscles.)

BY

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1. INTRODUCTORY.

THE treatment of septic war wounds divides itself naturally into three therapeutic procedures:

(1) In the *first* we have a number of different aims to pursue concurrently, and have therefore to be ceaselessly on the watch. We have to promote the destruction of the microbes which have been carried into the deeper tissues. We have to re-establish normal conditions in those tissues, resolving the infiltration in the walls of the wound and getting rid of the infected sloughs, and we have to prevent "the corruption of the discharges," and inhibit microbic growth in the cavity of the wound.

Further, during the whole period occupied by these operations we have to be constantly on our guard to prevent active and passive movements which would propel bacteria along the lymphatics, and carry poisonous bacterial products into the blood.

(2) When the microbes in the deeper tissues have been exterminated and physiological conditions have been restored, and the wound has been rendered to naked eye inspection perfectly clean, the difficult portion of our task has been accomplished, and the time has come for dealing with the surface infection.

(3) As soon as this has been suppressed, or all but suppressed, all our thought ought to be given to promoting the processes of repair, bringing together the tissues, and covering over the denuded surfaces.

2. INADEQUACY OF THE TRADITIONAL METHOD OF TREATING WOUNDS BY ANTISEPTIC APPLICATIONS, INCISION, AND MECHANICAL DRAINAGE.

Inefficacy of Antiseptic Applications.—The ordinary antiseptic combines with every kind of albumin. It thereby loses its bactericidal and its penetrative power. Its *bactericidal power* is, of course, not finally abolished until the antiseptic has encountered and combined with its full complement of albumin. Its *penetrative power*—and penetrative power means capacity for diffusing outwards through any medium in a chemically active condition—is, in the fluids of the wound, very rapidly abolished. For, when the medium which is to be penetrated contains even a trace of albumin, this will immediately quench the "*antiseptic emanation*"—meaning by this that fractional quantum of antiseptic which is carried out by diffusion into the surrounding fluids.

These general truths are firmly based upon experiment. It can be demonstrated that none of our ordinary antiseptics extirpate microbes enveloped in dead or living tissues, or in serous or purulent discharges; and that none diffuse into the walls or recesses of the wound. The sterilizing action of antiseptics applied in the wound will thus be strictly limited to the destruction of any microbes which may be lying bare; and sterilization will not extend beyond that portion of the wound surface to which the antiseptic is actually applied.

Inadequacy of Drainage as Usually Practised.—The theoretical requirements for a complete scheme of drainage are, *first*, that there shall be an outflow from the infected tissues to the external surface, or to the surface of a wound cavity; and, *secondly*, where a wound cavity exists, that there shall be drainage from that cavity to the exterior.

Drainage from the Tissues.—In the customary treatment of wounds, drainage from the tissues is not specially insisted upon—mere incision with or without fomentation being assumed to do in this respect what is necessary. In reality, however, in oedema only will sufficient drainage be given by this method. In tissues of normal density nothing like adequate effusion will be obtained, the lymph flow being here rapidly arrested by clotting and desiccation. And, where we are dealing with densely infiltrated tissues, incisions may fail to furnish even as much as a drop of exudation.

Drainage from the Cavity of the Wound.—Drainage tubes, of course, do not induce any outflow of lymph from the tissues. They drain only from the cavity of the wound—outflow ceasing as soon as ever the well head in the tissues dries up.

Summary of Criticisms on the Traditional Method of Treating Wounds.—It has appeared above (*a*) that antiseptics do not exert any effective action in the wound either in the direction of extinguishing the infection or keeping down bacterial growth; (*b*) that the usual procedure of incising and inserting drainage tubes provides, in place of that continuous welling out from the lymph spaces to the exterior which we require, a drainage which rapidly stanches at the source; and (*c*) that in the ordinary treatment of wounds no steps are taken to disperse infiltration; or accelerate the separation of the sloughs; or bring antibacterial lymph or phagocytes to the seat of infection.

In short, the treatment of wounds by a combination of antiseptics, incision, and mechanical drainage, is a therapeutic method which constantly disappoints, because it fails to kill the infecting microbes and at the same time fails to give to the organism opportunity for ridding itself of the infection.

And lastly—and this point cannot be too much insisted upon—in the ordinary treatment of septic wounds not nearly enough care is taken to prevent those active and passive movements which lead to the mechanical impulsion of microbes along the lymphatics, and to *auto-inoculations*.

3. THE IDEAL OF PHYSIOLOGICAL TREATMENT IS TO GIVE INTELLIGENT AID TO THE ORGANISM IN COMBATING THE BACTERIAL INFECTION.

Saline dressings supply a means for evoking, in the infected wound, certain requisite physiological reactions. By their aid we can, while at the same time inhibiting bacterial growth, drain the tissues, resolve infiltration, and promote the separation of the sloughs—besides giving other assistance.

4. PHYSICAL AND PHYSIOLOGICAL ACTION OF CONCENTRATED SALT SOLUTIONS.

(1) A concentrated salt solution will attract water; and, except in the case where a membrane which is impermeable to albumin is interposed, the outflowing current of water will carry out with it the whole of the protein substances which it holds in solution. This means that

hypertonic salt solution applied to tissues lying bare in the wound (or to granulating surfaces) will operate as a *lymphagogue* drawing out from the infected tissues lymph which has spent all its antibacterial energy, and drawing into the tissues from the blood stream lymph inimical to microbic growth.

(2) Brought into direct application upon leucocytes a hypertonic solution (what is in view here is a solution containing 5 per cent. salt) will disintegrate leucocytes, setting free the tryptic ferment they contain.

Such a hypertonic salt solution will also exert a number of inhibitory actions.

(3) It will inhibit the action of the tryptic ferment set free in the wounds.

(4) It will inhibit coagulation and so prevent the sealing up of the orifices through which lymph pours into the wound.

(5) It will inhibit leucocytic emigration into and prevent phagocytosis in the cavity of the wound.

(6) It will inhibit microbic growth.

5. Physical and Physiological Effects of Normal (0.85 per Cent.) Sodium Chloride Solution.

Normal solutions of sodium chloride exercise—as many other substances also do—a positive chemiotactic effect on white corpuscles. In other words, they will when applied to the surface of the wound bring leucocytes to the surface.

In moderately dilute solutions (solutions of 0.85 per cent. are here in view) salt does not interfere with the activity of trypsin, nor does it inhibit blood or lymph coagulation, phagocytosis, or microbic growth.

6. Therapeutic Employment of Hypertonic Saline Solution in the Early Stages of the Infected Wound.

By the time the patient reaches the *Casualty Clearing Station* his wound will generally have assumed the characters of a lymph-bound, infiltrated, and sloughing wound; or it will be fast getting into this condition. And even though under care in hospital the wound may have been coming out from this condition, it will, on long journeys, when redressing is difficult, be very prone to fall back into it. (*Vide infra, Subsect.* 14.)

The first requirement when we have an infected, lymph-bound, infiltrated, and sloughing wound will be—to get rid of the coating of scab and fibrin adhering to the surface of the wound, and set the lymph-flow going, to resolve the infiltration, and to promote the separation of the sloughs.

This involves two successive operations. In the *first*, we make use of the hypertonic solution undiluted; in the *second*, we turn its dilution to profit.

Stage in which the Hypertonic Solution comes into Operation Undiluted.

The striking feature here will be the outpouring of lymph. But there will at the same time: (*a*) in the depth of the tissues, (*b*) on the surface, and (*c*) in the cavity of the wound, be evoked other reactions which cannot be directly followed by the eye.

(*a*) *In the depth of the tissues* there will be substituted for the spent lymph which has been extracted lymph freshly drawn from the blood stream. This means that there will be substituted for a lymph which is favourable to the growth of all microbes indiscriminately a lymph which will stop the growth of *sero-saprophytic bacteria* and *imperfect serophytes* (such as the gas-gangrene bacillus); and at the same time seriously impede the growth of serophytic bacteria, above all the growth of the streptococcus.*

Further, the microbes in the tissues, which when immersed in the spent lymph were insusceptible, will, immersed in the fresh lymph, become susceptible to phagocytosis.

And in the induction of the phagocytosis in the interior of the tissues, the imbibed salt will, we may take it, play a contributory rôle. For we have seen that salt, appropriately diluted, stimulates leucocytic emigration.

(*b*) *In the more superficial regions of the walls of the wound and adhering sloughs*, the hypertonic salt solution will break down the leucocytes and set free tryptic ferment† —ferment which will, as we saw, not come into action so long as the concentration of the salt is maintained.

The coagulation of the lymph on the face of the wound will also, as we saw, be inhibited by the hypertonic salt solution.

(*c*) *In the cavity of the wound*, microbic growth will at the outset be completely arrested by the hypertonic salt, and it will, after the lymph has begun to pour out, be inhibited to different degrees according to circumstances by the combination of salt and antitryptic exudation.

So long as the salt solution is maintained at full strength, both emigration into and phagocytosis in the cavity of the wound will be inhibited.

Sum Total of Clinical Effects Produced by the Undiluted Hypertonic Salt Solution.—There will have been established, in the depth of the tissues, conditions favourable to the extermination of the microbic infection; and in the cavity of the wound conditions which will restrain microbic growth.

Stage in which the Dilution of the Hypertonic Salt Solution is turned to Profit.

As soon as the hypertonic solution in the cavity of the wound has been sufficiently diluted by outflowing lymph, the salt diffuses out from the infiltrated walls of the wound and the sloughs; and with this the tryptic ferment previously set free in these comes into action, and goes about its work of *cleansing digestion*—resolving the products of inflammation in the infiltrated tissues, and severing the connecting strands by which the sloughs are bound to the face of the wound.

At the same time—and this, be it noted, serves as a signal to the eye that the dilution of the salt solution has reached the point where all its inhibitory effects are abolished—leucocytes emigrate into the wound, and the discharge begins to assume a purulent character.

Now, also, the bacteria begin to multiply in the cavity of the wound.

We cannot afford to let all this go on very long unchecked. For as more and more trypsin finds its way into the exudate, or is set free in it from leucocytes disintegrated by microbic poisons, the effusion comes to furnish a more and more congenial nutrient medium for microbes, and the check imposed by phagocytosis is more and more completely removed. Finally, the exudate becomes tryptic, and if the redressing of the wound is any longer delayed, ground will now be rapidly lost (*vide infra, Subsect.* 12—*Indications which call for the redressing of the wound*).

It will have to be remembered, in connexion with this description, that the conditions will in every wound be perpetually changing, and that these changes will not keep time in the different parts of a large wound.

7. Under Certain Special Circumstances the Hypertonic Salt Solution should be used in a Different Way.

Method in which Hypertonic Salt Solution should be used when Gas Gangrene, Streptococcic Cellulitis, or other Acute Tissue Infection supervenes, or where we are dealing with an Infection of a Joint.—Our whole concern here must be to draw out as rapidly and exhaustively as possible the corrupted lymph‡ which occupies the tissue spaces, replacing this with uncorrupted lymph drawn from the capillaries. To achieve this we must, after freely incising the tissues, or opening the infected joint, apply hypertonic salt solution and maintain this in full strength until we have got the upper hand of the infection.

* The inhibition of microbic growth obtained with the serum of the patient with a large or even moderate-sized wound is much greater than that obtained with a normal serum. This, as comparative experiments have shown, is connected with the fact that the antitryptic power of the wounded man mounts up with very steep ascent (that is, in the course of a couple of days), to a level 3 to 8 times higher than the normal.

† The presence of trypsin in the wound can be very easily demonstrated. We need only collect a sample of pus or slough on a small swab of cotton wool; introduce this into milk containing ¼ per cent. of calcium chloride cryst., and then place this at a temperature of 50° to 55° C. (that is, in water just not too hot to hold one's hand in). If trypsin is present the milk will now rapidly clot. But it must be borne in mind in connexion with clotting obtained with a slough that since, under the conditions of the experiment, we dilute our material, our test will give a positive result even when we have in the wound sufficient salt to prevent the ferment being actually operative.

‡ This lymph has ordinarily lost some, and in very severe infections it may have lost all, its antitryptic power. Further, in gas gangrene—and let me here interpolate that we have in gas gangrene, when fully developed, a profound acid intoxication—the lymph in the focus of infection often shows a much diminished alkalinity.

Method in which the Hypertonic Salt Solution should be used where we are threatened with Secondary Haemorrhage.—Our aim and object here must be to prevent any digestive action in the neighbourhood of the endangered artery. Translated into practice this means that we must apply hypertonic salt solution and maintain it at full strength so as to prevent any trypsin which may be liberated in the wound coming into action.

8. GENERAL INSTRUCTIONS FOR THE CARRYING OUT OF THE LINES OF TREATMENT INDICATED ABOVE.

Concentration in which the Hypertonic Salt Solution ought to be brought into Application.—For all ordinary purposes the best hypertonic solution to employ is a 5 per cent. solution of common salt. Where we require more vigorous lymphagogic effect we may resort to a 10 per cent. solution, or even to a stronger solution. But these are very painful when applied to skin edges and sensitive granulations; and salt applied in saturated or nearly saturated solutions will often cause sloughing of the superficial tissues (*vide Subsect.* 10, *Footnote*).

Most Convenient Form of Stock Solution to keep on Hand.—The most convenient stock solution to keep on hand is a saturated saline solution, made by shaking up water with an excess of salt and then allowing this to settle. Such a solution contains at ordinary temperature 35 per cent. of salt.

Diluted 1 part of the saturated solution with 6 parts of water it gives a 5 per cent. solution.
Diluted 2 parts of the saturated solution with 5 parts of water it gives a 10 per cent. solution.
Diluted 1 part of the saturated solution with 39 parts of water it gives a 0.85 per cent. (physiological solution).

N.B.—Hot water should be employed for making the dilutions required for saline dressings and irrigations. For the physiological reactions which are to be evoked, whether these be active hyperaemia and transudation, or tryptic digestion, or emigration and phagocytosis, are all impeded by cold and favoured by heat.

9. METHOD OF APPLYING HYPERTONIC SALT SOLUTION SO THAT IT MAY PRODUCE AN ADEQUATE LYMPHAGOGIC ACTION, AND AFTERWARDS PROVIDE OPPORTUNITY FOR DIGESTIVE CLEANSING OF THE WOUND.

This will be the proper way of employing hypertonic salt solution in the infiltrated and sloughing wound. The following are the points to be borne in mind:

(*a*) For the achievement of an adequate lymphagogic effect, we must use quite considerable quantities of hypertonic solution. The dressings ought to come directly out of the hot solution, and be applied dripping wet.

(*b*) In order that there may follow upon the lymphagogic action a cleansing digestion, the amount of salt employed must be kept within such limits as will allow of its being within a reasonable period diluted by the outflowing lymph. In other words, we must not use too much hypertonic salt solution, nor use too concentrated a solution; nor supplement with large packs of saturated salt solution or salt tabloids.*

In order to anticipate that pullulation of microbes which will supervene when the exudate becomes tryptic we ought to redress the wound as soon as the discharge begins to be purulent.

The procedure in carrying out these principles will, of course, vary according to the anatomical conditions of the wound. In point of fact, three different anatomical types of wound have to be considered:

(*a*) The wound which from the beginning lay fully open, or which has been opened up so as to render every portion of its surface fully accessible;

(*b*) The wound where, owing to folds, or blind passages, or a tunnelled way, portions of the surface are not fully accessible; and

(*c*) Tubular wounds which are throughout their whole course more or less difficult of access.

(*a*) In the *first* case we have only to pack the wound with gauze thoroughly wetted in hot 5 per cent. salt solution. We cover this in with any impermeable tissue, such as jaconet. When the time comes for redressing the wound all trace of pus ought, before reapplying the saline, to be carefully removed. For pus treated with strong salt is converted into a sticky intractable substance which forms an impermeable coating on the walls of the wound.

(*b*) *Where the wound is pocketed or tends to flap together* the best procedure is to employ a bath of warm 5 per cent. saline. Should the position of the wound render immersion in a bath impracticable, it ought to be irrigated with warm 5 per cent. saline solution, the fluid being distributed over the whole surface of the wound by an arrangement of bandages.† The bath or irrigation ought to be discontinuous—intervals for digestive cleansing alternating with periods of lymphagogic and leucocytolytic action.

(*c*) Where we have a *tubular wound* it will, of course, be futile merely to insert a drainage tube, and cover its mouth with a piece of gauze wrung out of hypertonic salt solution. The rational procedure will here be to make windows in the tube, to cut it open longitudinally, and to lay into the hollow a folded strip of gauze, thoroughly wet with saturated salt solution. The tube thus armed is to be introduced into the wound after this has been syringed with 5 per cent. saline.†

10. METHOD OF APPLYING HYPERTONIC SALT SOLUTION WHERE WE WANT TO MAINTAIN ITS STRENGTH UNDIMINISHED, SO AS TO OBTAIN ITS FULL LYMPHAGOGIC EFFECT AND SUPPRESS ALL DIGESTIVE ACTION.

It will be remembered that this is the way in which hypertonic salt solution should be used where we are threatened with secondary haemorrhage, or are dealing with an infected joint, or with gas gangrene infection, or streptococcic cellulitis (*vide supra, Subsect.* 7). Let us consider how, using the ordinary hypertonic solution and the stock of solution of saturated salt, to effect our object in the three types of wound already referred to—the *completely* accessible, the *incompletely accessible*, and the *tunnel* wound.

(1) In the first variety of wound we, as before, pack with gauze thoroughly wet with 5 per cent. salt, but now reinforce by a backing of gauze thoroughly wet with saturated salt solution, and, as before, cover with some impermeable material. Or, as an alternative, we at short intervals renew the hypertonic solution, feeding this in with a syringe through a drainage tube going down to the face of the wound.‡

(2) In the case of the only *partially accessible wound* we resort as before to a bath of 5 per cent. saline or to irrigation with this solution, varying our procedure only in the respect that we make the bathing or irrigation continuous, or as nearly as possible continuous. When immersion in a bath and irrigation are both impracticable the wound ought to be dressed as in (1).

(3) In the case of the *tunnel wound*, we at short intervals renew the supply of salt; first withdrawing the old wick; then syringing out with 5 per cent. of salt; and then substituting for the old wick a new one taken fresh from saturated salt.

* In this connexion it will be well to emphasize that to fill into the wound cavity large numbers of salt tabloids must be pronounced wrong practice in the case where we judge the wound to be one which stands in need of digestive cleansing.

† This procedure might at first sight seem open to objection, (*a*) on the ground that saturated salt solution would here be brought into application upon the tissues; and (*b*) on the ground that to obstruct a drainage tube by gauze would be to render it useless. In connexion with the former objection, it will suffice to point out that direct contact of the saturated salt solution with the tissues is avoided by the interposition of the wall of the tube; and that the salt in the wick will come into operation only through the medium of the weaker salt solution with which the wound has been syringed out. In connexion with the latter objection, consideration will show that it is only in ordinary *drainage ex vacuo*; that is, it is only when we aim at keeping our wound cavity empty, and when we are dealing with viscid pus, and when unaided gravitation supplies in our scheme drainage our whole motive force, that it becomes incumbent to provide an unobstructed conduit to the exterior. In *drainage ex pleno* such as is here proposed we deal with a watery lymph effusion which wells over from the wound; and which only hermetical sealing could bank back.

‡ Another method which has been extensively practised is that of packing the wound with tabloids of salt, holding these off from actual contact with the tissues by several folds of gauze. This would seem to give in different cases different results. In certain cases—such as when an open knee-joint is packed with tabloids of salt, disposed throughout the gauze with close and regular interspacing—the interior of the wound remains perfectly dry. The explanation would seem to be that the salt here comes into application in the form of a saturated solution all over the surface of the wound, condensing the tissues until they become impermeable to lymph; and at the same time pickling them in such a way as, perhaps, to restrain all microbic growth in their interior. In other cases—for example, where a bagful of tabloids is introduced into the well of a large wound—there is obtained the ordinary lymphagogic effect. Here it would seem that the salt operates in form of a saturated solution upon the portion of the wound only lying nearest to the tabloids. And hereabouts the tissues look and feel exactly like pickled meat. In regions more remote from the tabloids the salt will naturally be much less concentrated. And it is presumably from these regions that the copious lymph outflow is derived.

11. NATURE OF THE EXTERNAL COVERING TO GO OVER THE WET SALT DRESSINGS.

The most usual practice is to place immediately outside the saline dressings a thick packing of dry cotton-wool, and again outside this a bandage. This seems to be dictated by the idea that the cotton-wool will soak up the discharges, and the notion that the capillarity of the cotton-wool, and evaporation from its outer surface will reinforce the drawing action of the salt. In point of fact, however, all the cotton-wool does is to suck out some of the salt solution from the dressings, and to evaporate this to dryness, putting in this way a certain quantum of salt out of action. Moreover, the notion that capillary action and evaporation would promote drainage from the tissues is in conflict with everyday experience, which shows that when we apply a dry dressing or let a wet dressing evaporate, the outflow of lymph from the wound ceases, and the dressing sticks to its surface.

The rational method of covering in saline dressings is to use, instead of cotton-wool, an impermeable covering.* Then, instead of the salt solution being carried outwards by capillarity and evaporation, it will, by diffusion, be carried inward.

The difficulty that with this form of dressing discharges will escape from under the impermeable covering can be met either by frequent redressing or by placing cotton-wool outside the jaconet.

In the case of wounds of the extremities perhaps the simplest method of all is to dispense with all coverings over the salt dressings, merely renewing the salt packs at frequent intervals. But here, if we want to clean off sloughs or resolve infiltration, we shall have to alternate with our dressings of hypertonic saline solution dressings of physiological saline solution.

12. INDICATIONS WHICH CALL FOR THE REDRESSING OF THE WOUND.

A septic wound requires to be redressed under two quite different conditions.

(*a*) It requires redressing as soon as tryptic ferment is set free in the cavity of the wound, such trypsin being set free from leucocytes broken down by microbic growth.

For here, as soon as the originally antitryptic exudation becomes tryptic, all manner of sero saprophytic microbes will multiply unrestricted; and bacterial poisons may be absorbed; and, at the same time, phagocytosis will be inhibited; while the young tissue elements, which are the agents of repair, will be subjected to destructive digestion.

(*b*) Again, every septic wound ought to be redressed as soon as it becomes lymph-bound.

For as soon as the exudation stanches and lymph fresh from the blood ceases to come into application, the microbes in the tissues, being now no longer inhibited by their growth or phagocytosed, find congenial conditions and multiply.

It requires to be emphasized in connexion with these two indications for redressing that in the case of the septic wound intervention is much less urgently called for, where we have *retention of corrupted discharges*, than where the wound becomes *lymph-bound*.

In the case of the *former* all we have to fear is a pullulation of microbes in the cavity of the wound, some absorption of septic products, and some injury of the tissues of repair.

In connexion with a *lymph-bound wound* we may at any moment have a wide extension of the tissue infection, taking the form of gas-gangrene or streptococcic cellulitis.

13. PRINCIPLE UPON WHICH CASES OUGHT TO BE CHOSEN FOR REDRESSING WHERE PREFERENCE MUST BE GIVEN TO THE MORE URGENT.

What has been said above on redressing ought to be specially kept in mind where it is impossible to inspect and redress every wound.

In such cases the surgeon has, as a rule, simply pursued the practice followed in ordinary aseptic operation wounds. That is, he has with a view to preventing the invasion of microbes from without, redressed the cases where the discharge has soaked through, giving to these preference over those with unsoiled dressings.

In septic wounds—for here the microbes are in the citadel and not outside the walls—we ought to follow an exactly opposite policy. Where the outside dressings are wet with discharge, in other words, when presumably lymph is being actively poured out, we may be confident that the wound is not coming to any harm. We may accordingly, when other work presses, quite properly postpone redressing such cases. The contrary will hold of a gravely wounded man whose dressings are unsoiled. In such a case it is always possible that we may underneath quite clean dressings have a lymph-bound wound. We ought without delay to satisfy ourselves with respect to this.

14. PRECAUTIONS TO BE TAKEN IN HANDLING THE WOUND TO PREVENT AUTOINOCULATIONS AND A DISPERSAL OF SEPTIC INFECTION ALONG THE LYMPHATIC CHANNELS.

Like the acutely sick all the wounded are suffering from a bacterial infection. And the same general therapeutical principles apply. So long as microbes in large numbers are harboured in the tissues we have pyrexia. And the patient's condition will be aggravated by all dispersion of the infection and absorption of bacterial poisons into the blood. So that in every case the infected man will need to be kept at rest; and the really heavily infected will require to be kept at *absolute rest*.

This requirement is, of course, in the case of those suffering from infected compound fractures more or less perfectly complied with by the application of apparatus for fixing the limb.

But not only wounds complicated by fracture, but all wounds with the infected tissues in their neighbourhood, ought so far as possible to be immobilized. Moreover, this ought to be begun immediately after the wound has been inflicted, and to be continued so long as appreciable infection persists in the depth of the tissues.

In connexion with operative procedures it is, of course, impracticable to conform completely to this requirement. But none the less the requirement should never be lost sight of. It is scientifically reprehensible to cast loose, as is so often done under an anaesthetic, a fractured limb from all splints, deliver it over to an orderly for energetic washing and disinfection, and permit the foot or hand below the fracture to be used as a handle for raising or turning over the limb. All the necessary passive movements ought to be reduced to an absolute minimum. And the light hand of the skilful surgeon will, in operating on an infected case, be a very valuable asset.

In the same way, seeing that very efficient apparatus has now been devised, fractured limbs ought no longer to be put up in such a way as to allow of sagging or displacement during redressing.

Again, in changing the dressings on large flesh wounds on an arm or leg, great care ought to be taken not to manipulate, or flex or extend, or unnecessarily disturb the position of the limb.

It is difficult to doubt that when these precautions are neglected bacteria from the infected area will be propelled along the lymphatic channels in the direction of the heart. And measurements of the opsonic power of the blood and, indeed, simple inspection of the charts, establish that all readjustments of the position of a fractured limb, and probably all redressing of large wounds, are followed by elevations of temperature corresponding to very serious autoinoculations.

The same will, of course, apply to shocks and jolts received when the infected patient is being carried from the ward to the operation theatre, or is being transported by train or motor.

15. MANNER IN WHICH WOUNDS SHOULD BE DRESSED IN PREPARATION FOR LONG JOURNEYS DURING WHICH THEY CANNOT BE KEPT UNDER CLOSE OBSERVATION.

What has been said in the preceding subsections has an important bearing upon the procedure to safeguard the patient against that delay in redressing which is inevitable during the long hours which will be consumed in travelling from the front to the base, or from the base to England, and in settling down into a new hospital. The danger from microbic pullulation in the cavity of the wound and,

* The prejudice against the use of impermeable coverings no doubt originates in the observation that discharges, w en confined after they have become tryptic, will set to work and digest the surface of the wound. The proper remedy is not to discard the impermeable covering, but either to redress before the discharges become tryptic, or prevent them becoming tryptic.

tryptic digestion, and, on the other hand, the much graver danger of a tissue infection taking origin in a lymph-bound wound, have here to be provided against. This means that we have to arrange for a continuous outflow of lymph, and at the same time to arrange for the surface of the wound being kept thoroughly wet.

The proper course will be to dress the wound as indicated in *Subsects.* 10 *and* 11, *supra*, applying outside the impermeable covering dry cotton-wool. Thus treated the patient may arrive at his destination with soaked dressings, but he is not likely to arrive with corrupted pus, and we can be practically certain that he will not arrive with a tissue infection spreading from a lymph-bound wound.

16. Method of Correcting certain undesirable After-effects which may supervene upon the ill-considered, or too long continued, use of Hypertonic Salt Solutions; and Indications as to when the Hypertonic Salt Solution ought to be discarded in favour of a weaker Solution.

The *rationale* of the therapeutic employment of hypertonic solutions is, as we have seen, to be found in the fact that (1) they drain the tissues; (2) break down the leucocytes in sloughs and in the walls of the wound, and so give us, quite apart from any destruction of leucocytes by microbic agency, the trypsin we require for the digestive cleansing of the wound; (3) they produce active hyperæmia; (4) prevent clotting of the lymph in the walls of the wound; (5) suspend the action of the tryptic ferment set free from the leucocytes; and (6) inhibit bacterial growth—the inhibitory actions last in question being exerted only so long as the strength of the salt solution is maintained. In addition—but this counts of course as a disadvantage and not as a therapeutical asset—hypertonic solutions repel leucocytes and prevent phagocytosis.

If we want, in employing hypertonic salt solution, to turn its therapeutical qualities to best advantage, we must be continually on the watch to anticipate and correct any of the defects of its qualities.

(1) Where blood continues to ooze from an operation stump or wound which has been packed with hypertonic salt solution, this will be due to this anticoagulative agent having been applied before bleeding has stopped. The proper procedure will always be to postpone the use of hypertonic salt until all oozing of blood has ceased. Applied then, the salt will not resolve the blood clot; and where the hypertonic solution applied is a 5 per cent. solution, a very little dilution will bring it to the point when blood clotting will no longer be inhibited.

(2) When the face of the wound is found covered with a firmly adherent glutinous coating, this has been derived from leucocytes broken down by the direct application of strong salt.

The way of avoiding this obstacle—it is, as a matter of fact, a serious obstacle to effective draining and irrigation—is to clean out all pus from the wound before bringing the hypertonic salt solution into application.

(3) Where, as very rarely happens, the granulations become oedematous this will be due to the over-prolonged application of concentrated salt solutions.

It would seem that here the salt which is imbibed into the granulations is not sufficiently promptly carried off by the circulation, with the result that fluid is drawn into the salt-impregnated tissues, both from the underlying strata and also, when their salt content diminishes, from the discharges.

The remedy will be to discontinue the application of salt, and to apply hot fomentations in order to activate the circulation and promote absorption.

(4) Where the granulations assume a bright coral red colour and bleed at the least touch, it will be well to reduce the concentration of the salt solution—in the case where drainage of the tissues is still required to 2.5 per cent., and in the case where no further lymphagogic effect is required to 0.85 per cent.

(5) Quite apart from the development of any undesirable secondary effects, it will be well, as soon as every trace of induration has disappeared and all sloughs have been got rid of, to substitute for the hypertonic a physiological salt solution.

The *rationale* of this is that there will here still remain on the face of the wound, even though it looks to the naked eye perfectly clean, serophytic microbes, which, though quite at home in the serum, can be killed by phagocytosis.

In order to kill these—and let us note that they are not killed but only inhibited in their growth by hypertonic salt solution—we must bring leucocytes to the surface of the wound.

17. Therapeutic Application of Physiological Salt Solution.

What remains to be done is (*a*) to destroy the serophytic bacteria—streptococci and staphylococci—which still survive upon the face of the wound; and (*b*) to reduce the extent of surface lying open to infection, holding before ourselves always as an ideal the closure of the wound by secondary suture.

Destruction of the Serophytic Microbes remaining on the Face of the Wound.—A surface infection such as we have still to deal with can be effectively combated by keeping the wound wet with physiological salt solution, and redressing at short intervals. The application of physiological salt solution will, as we have seen, promote the emigration of phagocytes, the frequent redressing will prevent the setback that will occur every time that leucocytes die off and set free their trypsin in the wound; and the combination of the two will, in the case where the deeper tissues have been freed from infection, either exterminate the surface infection, or at any rate so nearly exterminate it as to make it safe to embark upon an operation for the closure of the wound.

18. Final Stages in the Treatment of the Wound.

Conditions under which Wounds may be Closed by Secondary Suture.—Secondary suture may be safely embarked upon when we have favourable bacteriological conditions in combination with favourable anatomical conditions.

The bacteriological conditions may be pronounced favourable when (*a*) microscopic examination of fluid from the depth drawn out by a "lymph leech"; or, failing this, clinical evidence points to the probability of our having got rid of all the deep infection, and when (*b*) stained impression preparations made from the wound surface show that we have there large numbers of perfectly well-conditioned polynuclear leucocytes, and a complete absence of microbes, or only here and there a stray microbe.

The anatomical conditions are favourable when we can, with or without undercutting, bring together the skin edges without putting too great a strain upon the sutures, or leaving underneath any hollow spaces. The operation of secondary suture may be undertaken either before the wound surfaces are covered in with granulations, or subsequent to this—the former of these dates being, from the bacteriological point of view, the more favourable, in the respect that there will be less risk of infection lurking below the surface.

It will, in every case, be advisable—for the conditions may change within the lapse of a few hours—to let the operation follow immediately upon the examination of the impression preparations.

In connexion with secondary suture, as in every other case where a wound is sewn up without adequate guarantee for its asepticity, it will always be imperative to keep the patient under the anxious observation of the operator for at least a week afterwards.

Procedure where the Wound cannot be Closed by Secondary Suture.

When the anatomical conditions do not allow of the wound being closed by secondary suture, we must fall back on the policy of persistently combating the surface infection, consolidating the granulations, and encouraging the covering in of these by epithelium. In the present state of our knowledge perhaps the best we can do will be to employ dressings of physiological salt, or, better, of Ringer's solution (for this contains a large assortment of physiological useful salts), redressing the wound frequently. Where we are dealing with a large defect of skin, grafting may usefully be resorted to.

REFERENCE.

[1] See the author's Memorandum on the Irrigation of Wounds, BRITISH MEDICAL JOURNAL, October 16th, 1915; and *Lancet*, October 16th, 1915.

British Medical Journal.

SATURDAY, JUNE 3RD, 1916.

THE POSITION OF MEDICAL MEN UNDER THE MILITARY SERVICE ACTS.

THE Central Medical War Committee, the Scottish Medical Service Emergency Committee, and, for certain special cases, the Committee of Reference formed by the Royal College of Physicians and the Royal College of Surgeons, are now recognized under the Regulations made under the Military Service Acts as the Professional Committees for all medical men who come within the provisions of those Acts. The effect of this recognition is that every medical man, married or single, under the age of 41 next birthday, and consequently liable for service in the army, will be subject to the decision of one or other of these three committees on the question whether it is his duty to take a commission in the R.A.M.C. or to continue to carry on his work as a civilian practitioner.

At the present time practitioners of military age in England and Wales may be divided into those who have enrolled and those who have not enrolled under the scheme of the Central Medical War Committee, the former being in the majority. A medical man under 41 who has enrolled will not be called up for service with his class by the recruiting authorities. He will continue in his present occupation, but be liable to be called upon to take a commission in the R.A.M.C. if and when the Central Medical War Committee decides that it is his duty to do so. If by inadvertence such an enrolled man receives a notice from the recruiting authorities calling him up, the production of his certificate of enrolment restores him at once to his proper position in accordance with Army Council Instruction 485 as follows:

> (*a*) If a qualified medical practitioner who is attested under the Group System, or is in one of the classes under the Military Service Act, 1916, and who is enrolled under the scheme of the Central Medical War Committee or the Scottish War Emergency Committee, or has been provisionally accepted by the War Office, receives a notice paper calling him up, he should return it to the recruiting officer, together with his certificate of enrolment or War Office letter. The notice will then be cancelled, and the practitioner will remain in reserve until selected for a commission in the Royal Army Medical Corps.

In Scotland the same procedure applies with regard to those who are registered with the Scottish Medical Service Emergency Committee.

There is, however, one important modification in the position of the enrolled man under 41 which has resulted from the passing of the new Military Service Act. Hitherto medical men who have taken service since the beginning of the war, as doctors in the army, have done so on the system of a contract for one year or until their services are no longer required, whichever happens first. It is now announced authoritatively that every medical man under 41 is, in virtue of the new Acts, under an obligation to serve not only for twelve consecutive months, but for further periods of twelve months, with such intervals as may be determined, if the military authorities (acting on the advice of the Professional Committees) require him to do so.

In view of the obligation that now exists on all other classes of the community to serve for the duration of the war, the medical profession will not, it may be assumed, object to this new condition in the case of men under 41. While service with the forces remained voluntary, the Central Medical War Committee was fully aware that a medical man by enrolling undertook no more than an obligation for one year of service, if required of him. At the same time the Committee always contemplated the possibility that circumstances, such as the prolonged duration of the war, might necessitate a further call on men who had completed a year's service. For this reason each medical man, on the completion of his period of service in the R.A.M.C., was invited to renew his enrolment, thus placing himself again at the disposal of the army, should the Committee advise that his services were required at any subsequent date.

Under the new conditions every medical man under 41 who at the end of his period of commissioned service elects to return to civil life will come under the compulsory provisions of the Military Service Acts, and unless he at once enrols again so as to obtain the privileges afforded by Army Council Instruction 485, he will be liable to be called up for ordinary service by the recruiting officer. He will, no doubt, consider it advisable to enrol, and he will therefore again come before the appropriate Professional Committee for commissioned service in the R.A.M.C. so soon as the Committee thinks it is his turn to be taken again. What interval should be allowed between the end of his first period and the beginning of his second period of service will be determined by the Professional Committee. It may be presumed that the Professional Committee will not select an enrolled doctor for a second period of service while other men equally eligible in other respects have not been taken for service. The enrolled medical officer, therefore, who is completing his year's service may reasonably hope that it will usually be found possible to arrange that the second period of service, if any, which he will be called upon to render will not be directly consecutive to the first period, but that there will be an interval, the exact duration of which it is not possible to state, inasmuch as it will depend upon the national requirements at the time; at the same time any medical officer who prefers that his service in the R.A.M.C. should be continuous may, as heretofore, re-engage at the end of his year.

With regard to the medical men under 41 who enrolled before the passing of the Act, the Central Medical War Committee cannot consider them to be morally bound to give more than one year's service on that enrolment. Among them are some who are now engaged in their first year's service in the R.A.M.C. and others who have not yet held a commission. In addition there are the men who have already done a year's service in the R.A.M.C. and have resigned their commissions. There is no doubt that the man under 41 who at the end of his year's service resigns his commission should enrol again under the new conditions, realizing, of course, that the obligation is now, in virtue of the new Act, not limited to one period of service of twelve months, but extended to such further period or periods as may be found necessary in his case by the War Office, acting on the advice of the Professional Committee. By enrolling he will be helping to retain for the medical profession certain privileges, for doctors will then continue to be able to fulfil their obligation for military service.

not in the ranks, but by becoming commissioned officers, as, if enrolled, they will not be called up by the recruiting authorities for military service under the compulsory provisions of the Military Service Acts, and their obligation to serve (qualified in these ways) is actually exacted from them only if and when it is deemed necessary and right by a committee of their own profession established for the purpose.

There remains the case of the medical man under 41 who does not enrol under the conditions created by the new Military Service Act. He will not have the advantages of Army Council Instruction 485, quoted above; he will be called up by the recruiting officer in his class, and if he does not desire to be taken for general service it will be necessary for him to apply to the local tribunal for exemption. Under Section 7 of the new Military Service Act,[1] which deals with medical men, the local tribunal will refer his case, unless his objection be conscientious, to the appropriate Professional Committee. This Committee will consider any facts brought before it, and will determine whether he is or is not needed in his locality, and will make a recommendation accordingly to the local tribunal. If the local tribunal is advised that he is not needed in the locality it will refuse him exemption, and the military authority will then call him up under the compulsory powers of the Military Service Acts, and the War Office, unless it considers him unsuited for the R.A.M.C., will presumably give him a commission in that corps.

The recommendation of the Professional Committee is binding on the tribunal. It will be seen, therefore, that whether a man has enrolled or not, his case will be decided by one and the same Professional Committee. But as the man who does not enrol will be under the compulsory provisions of the new Military Service Act, and as he has no privileges (not being enrolled) under Army Council Instruction 485, the War Office will make his commission in the R.A.M.C. for the whole period of the war and on the ordinary lines, without any of the special arrangements as to pay, or a twelvemonth period of service, or otherwise, that have hitherto obtained in this war for medical men taken into the R.A.M.C.

The position of a medical man *over* 41 is not affected by the Military Service Acts. It is, however, open for him to enrol, for he is eligible to receive a commission for general service in the R.A.M.C. until he has attained the age of 45, and there can be no doubt that unless he enrols and so places his services at the disposal of his country if and when required, the position with regard to certain areas will be very difficult, and the calling up of men for service in the R.A.M.C. will involve hardship to the community and to his fellow practitioners. It may be assumed that a sense of patriotism and the spirit of fairness will lead every man from 41 to 45 to enrol, in order that the necessary selection may be made from the widest field possible. Between these ages service is voluntary, and no man over 41 will be called upon, unless he so desires, to give more than one year's service under the undertaking given when he enrols. The conditions in his case remain precisely as they were before the passing of the Military Service Acts.

The war must be won at any cost. An efficient medical service is an essential part of military organization. Unless a doctor is convinced that he knows how the war can be won without him, he must trust some one to tell him his duty as matters now stand. And the only body which can do this from wide knowledge and in an equitable manner is the Professional Committee of the country to which he belongs.

[1] This section is printed at p. 802.

THE CAMPAIGN FOR CLEAN MILK.

So many valuable lives are being lost in the war that the importance of cutting down our infant mortality to the lowest possible figure is being realized more generally than ever before. Much good work is being done by the medical men in charge of clinics for infants, the managers of schools for mothers, the home visitors provided by municipalities, by the many various associations that exist to improve the welfare of the poor, and by other useful organizations designed to lessen this mortality, which is still notoriously unduly high. Many of the fatal diseases to which infants are prone are due directly to the consumption of impure milk. In the great majority of instances this impurity, or contamination with pathogenic bacteria, is avoidable; the infection of the milk occurs habitually on the dairy farm or in the course of transit from dairy farm to consumer. No medical man can doubt that the dangers to which infants and young children fed wholly or largely on cow's milk are exposed could be enormously reduced by legislative and administrative measures directed to procuring the general supply of uncontaminated milk to the public, and to preventing the supply of impure milk, or milk contaminated with bacteria of all sorts. These observations are, of course, platitudes. But they are worth restating in view of the great importance of the subject and the campaign for clean milk that has been organized by the National Clean Milk Society. This society has recently republished in pamphlet form[1] a series of articles that appeared week by week in the *Observer* at the end of last year and the beginning of this. They were written and published with the hope that they might be the means of stimulating interest in a subject which is of prime importance to the welfare of the country. The condition of our milk supply is bad, and cannot, it is maintained, be much improved until the public clearly understands the relative values of clean milk and dirty milk, and demands and is willing to pay a higher price for the clean milk. The society, which is incorporated, has been formed with the objects of raising the hygienic standards of milk and milk products, and of educating the public as to the importance of a clean and wholesome milk supply. The pamphlet gives an admirable account of what has to be done and how the necessary improvements are to be effected. Accounts are given in general terms of the reforms required in farm practice, in the conveyance of milk, in the licensing of milk dealers, and in other important details affecting the supply and the domestic consumption of milk. The pamphlet might be read with advantage by millions of milk-consumers in this country; it has been written for the layman, and in the form of a cheaper reprint, if that be possible, it should have a very extensive circulation. The problem of obtaining a supply of pure milk is naturally one that affects other countries as well as ours, and has received a great deal of attention in the United States of America during the last quarter of a century with, in many towns, most satisfactory results. In India also it is now being discussed. We have before us an excellent account of the milk problem in Indian cities, with special reference to Bombay,[2] discussed at length in its scientific, sanitary, economic, and legislative aspects. Much remains to be done in improving the breed of milch cattle in India; on the other hand, it is said that tuberculosis is extremely rare among cows in Bombay and has never been found in buffaloes, while tubercle bacilli have never yet been detected in Bombay milk, so that the elimination of tuberculous cows cannot in India be the difficult problem it has always shown itself in Great Britain. Dr. Joshi's book is full of important facts and

[1] *Campaign for Clean Milk.* A series of articles that have appeared in the *Observer*. London: Published by the St. Catherine Press for the National Clean Milk Society (Incorporated). 1916. (Demy 8vo, pp 51; illustrated. 1s. net.)

[2] *The Milk Problem in Indian Cities, with Special Reference to Bombay.* By L. L Joshi, B.Sc., M.D., Municipal Analyst, Bombay. With a Foreword by J. A. Turner, C.I.E., M.D., D.P.H., Executive Health Officer, Bombay Municipality. Bombay: D. B. Taraporevala, Sons, and Co. 1916. (Demy 8vo, pp. 245.)

figures bearing on the whole subject, and should form a sound basis for the discussion of the practical reforms that are called for in the provision, collection, and distribution of pure milk in India. Here, as elsewhere, the co-operation of the milk-consuming public is essential for the success of any scheme put forward by the Government and municipal or other authorities that may interest themselves in the great milk question.

EPIDEMIC JAUNDICE DUE TO B. PARATYPHOSUS B.

Professors Frugoni and Cannata have recently recorded[1] a small epidemic of catarrhal jaundice among Italian soldiers stationed in the valley of the river Judrio, a tributary of the Isonzo, on the eastern Austro-Italian border. In the course of two months about a hundred cases were seen in hospital. In some instances the jaundice was the only symptom or sign of disease, but in most cases there had been for from two to four weeks diarrhoea (perhaps with slight fever), loss of appetite, and a sense of heaviness or even pain in the epigastrium. This pain was noted in over half the patients, and was attributed to tension of Glisson's capsule of the liver. The jaundice followed on these disturbances after the lapse of various periods of time, and reached various degrees of intensity, as is commonly the case with ascending cholangitis secondary to gastro-enteritis. Mild fever was noted at the onset of the jaundice in a quarter of the patients; the stools were cretaceous in 54 per cent. early in the jaundice, later becoming normal in colour in the usual manner. The authors were not in a position to determine experimentally whether these cretaceous stools were alcoholic or merely fatty, and leave the point unsettled. But by the use of Einhorn's duodenal sound they were able to prove that the secretion of bile was "sufficiently deficient" in the first days of the jaundice, and was normal or even greater than normal during convalescence. Their use of the duodenal sound also showed them that a part, at any rate, of the biliary obstruction in these patients was due to the presence of little blocks of mucus in the thickened biliary secretion. By prolonging the stay of the sound in the duodenum they were able to obtain some bile from it in every instance, although sometimes in very small quantities. Bradycardia was observed in 52 per cent. of the cases, and in some was (*pace* Dr. Mercier) very marked. No tendency to haemorrhage was seen. The liver was enlarged in every case, but not in proportion to the jaundice; the gall bladder was palpable in a few patients, and painful in a few. The spleen was enlarged in 60 per cent. of the cases, and most so in the patients in whom the liver was most increased in size. The etiology of this jaundice was submitted to examination in 48 of the patients by the employment of Einhorn's duodenal sound, blood cultures, and tests for agglutinating power in the serum. The blood proved sterile in all cases. The bile gave cultures of *B. paratyphosus* B in 11 patients and of *B. typhosus* in 1; from the clinical point of view there was nothing to distinguish these 12 patients from the other 36 whose bile proved sterile on culture. The agglutination tests showed that the serum of 15 of the patients agglutinated *B. typhosus* when diluted 1 : 50, and one when diluted 1 : 100; all had received antityphoid inoculation. As regards *B. paratyphosus* B, one of the eleven infected patients gave a positive result at a dilution of 1 : 50, nine at a dilution of 1 : 100, and one at a dilution of 1 : 200; of the remaining 37 cases investigated, five gave a positive result at a dilution of 1 : 50, and one at a dilution of 1 : 100. None had received antiparatyphoid vaccination; nor did the serum of any of them agglutinate *B. paratyphosus* A. Examination of the faeces showed that in only three instances could *B. paratyphosus* B be recovered out of 48; but this method of examination was taken up too late in the day for the results to be completely trustworthy. The authors remark that this epidemic of jaundice occurred at the end of an epidemic of "typhoid" fever; they conclude that the infecting bacilli had become attenuated and less virulent, and so produced jaundice rather than a "typhoid" fever. Paratyphoid B fever has been increasingly common in the Italian army; the authors add that abnormal types of typhoid and paratyphoid fevers have often been recorded during the present war, such as apyretic typhoid in Germany (Meyer), and infectious jaundice (Raymond and others) in the Vosges and Tripoli and the Dardanelles, as well as in Italy.

[1] *Lo Sperimentale*, Florence, 1916, lxx, 25.

THE IMPERIAL COLLEGE OF SCIENCE.

A large company of representatives of the scientific and technical press were received at the Imperial College of Science, South Kensington, on May 31st by the Right Hon. Arthur Dyke Acland, chairman of the executive committee of the governing body, and, with the professors and other members of the staff, took them round the institution. The college, of which Sir Alfred Keogh is rector, has now as many ramifications as a great tree has roots, but the departments of chemistry, electrical engineering, and metallurgy chiefly engaged the attention of the visitors. Professor H. B. Baker, who occupies the chair of chemistry, said that the scientific investigation carried on at the college had an industrial bias, and the great need at the present moment was for what he described as semi-laboratories, that is to say, places in which scientific research, having passed the initial stages, could be continued on a scale of operation and equipment approximating to that which obtains in industry. Among a score of subjects for investigation already in hand, or to be undertaken as soon as opportunity offers, were the disease-producing organisms of animals from a comparative point of view, economic plant physiology and pathology, and methods of destroying house-flies. Various types of respirators as a means of protection against poisonous gas had been evolved in the college, and also a practicable method of purifying water for the supply of troops. Much attention had been paid also to the manufacture of synthetic drugs; at a time of threatened shortage owing to the stopping of external supplies, the laboratories set to work, and within three weeks the supply of three essential drugs for hospital purposes was assured. Mr. Acland referred to the memorial which has just been presented to Lord Crewe by the professors of the college, urging the importance of securing that a larger proportion of young men in this country should be trained in scientific methods with a view to industrial research. The suggestion is that a grant of a quarter or half a million, in addition to the quarter of a million (as against Germany's million and a half) which the State annually grants to the universities might profitably be used to provide an adequate number of bursaries for secondary-school boys of 16 to 18 years of age, to be followed by the offer of Government scholarships tenable at a university.

CATGUT.

The Académie de Médecine on May 16th, after discussing a report presented by M. Quénu on May 9th, adopted a series of resolutions as to the manufacture of catgut and as to its sterilization. The resolutions as to manufacture were: (1) That catgut for surgical use should be made only from fresh bowel, and that a clause to this effect should be introduced into all contracts; (2) that special precautions in the selection and treatment of intestine for this purpose should be enforced in slaughterhouses; and (3) that in the factories where gut is prepared, special rooms should be set apart for the preparation of catgut for surgical use, and that the apparatus in them and the training of the workpeople should be improved. The

resolutions as to sterilization were to the effect that tubes of catgut sterilized by pharmacists should be subject to some outside control, and should bear a label stating the nature of this control and the place of origin of the catgut.

PRISONERS IN GERMAN CAMPS.

How is it that our Government is so ill informed as to the treatment of prisoners in German camps? On April 13th Sir Edward Grey admitted that neither he nor his colleagues had any suspicion of the horrors of Wittenberg, adding that they had no reason to suppose that the state of things was the same in other typhus-infected camps in Germany. Yet the truth might have been discovered from sources easily accessible. An account of the outbreak at Gardelegen by Major P. C. Davy and Captain A. J. Brown was published in our issue of November 20th, 1915, and a summary of Dr. Léonetti's experiences of similar epidemics at Cassel and Langensalza was given in the JOURNAL of March 18th, 1916. These accounts are confirmed by independent testimony quoted in the JOURNAL of May 6th.

If more evidence is wanted we may refer the Foreign Office to Dr. Ribadeau-Dumas's record of his own experience of German prison camps. He is a Paris hospital physician, and his testimony, which is published in *Paris Médical* of May 20th, therefore carries special weight. After a period of detention at Altengrabow, he, with a number of other doctors, French and Russian, was sent on February 8th, 1915, to the camp at Stendal. Th re the prisoners were persecuted in all sorts of ways. The state of things was so bad that the higher authorities seem to have become alarmed, and an order was issued enjoining prudence on those in charge of camps, as "too severe treatment inflicted on the prisoners was likely to tarnish the good name of Germans among neutrals." In consequence, some of the officers strove to undo the evil effects of the previous reign of terror. A delightful example of Teuton tactfulness is given in a story of one of them offering the French prisoners cotton caps bearing the marks of French military hospitals! War is war, and the caps were loot like anything else. On the occasion of some popular festival in the town huge baskets were brought in with much ceremony, and bits of cloth stolen at Lodz were distributed among the prisoners, who were ordered to wear them as cravats in token of German liberality; but no useful thing, such as a shirt or a piece of linen, was ever given. Typhus broke out and the Germans fled, leaving the French and Russian doctors with the sick within a barbed wire enclosure, where the conditions were most unfavourable. Several of the medical men fell victims to the criminal want of forethought of those in charge of the camp. The Government was moved to take action only when the disease began to spread among its own people. Then isolation huts were built, disinfectors and baths set up, and, by way of throwing dust in the eyes of the public, antityphoid inoculations were carried out on a large scale. Ribadeau-Dumas speaks strongly about the food supplied to the prisoners; it was not only deficient in quantity, but extremely bad in quality. At Stendal the staple ration was what was called potato soup, a filthy decoction with herring heads floating in it, and smelling of rotten fish, which the very dogs howled at. Miserable as the food was, the prisoners fought for it. Parcels sent from home were opened and the contents stolen. Punishments in the form of blows, kicks, and short commons were showered on the prisoners; the doctors were placed under arrest without any reason assigned; some were confined to their rooms for months. The lazaretto was barely furnished; the beds were mere frames covered with mattresses of wood shavings and a coverlet. The medicines consisted of aspirin and quinine tablets, tincture of iodine, castor oil and potassium chlorate. There were only a few instruments—a worn-out tongue depressor, two crooked stylets, and a jagged bistoury. The German doctors were, as a rule, rough, sometimes brutal, in their manners; they physicked the patients at haphazard; some were grossly ignorant. Wounds were stitched up with a mattress needle and unasepticized thread; the surgeons did not wash their hands. This description of German surgery may be compared with that given by Léonetti in his *Souvenirs de Captivité*. Ribadeau-Dumas complains bitterly of the utter neglect with which the sick prisoners were treated. Inspections were a farce. Once they saw a General, to whom they were allowed to speak, but after listening to the recital of their woes, he said that that kind of thing did not concern him, and walked away. At Altengrabow, in reply to some complaint, another General merely called them "sagrés gôchons." These are the only occasions on which they had any relations with the higher German authorities. The neutral inspectors they never saw. One day the French prisoners refused the soup, which was unusually bad. They were made to stand motionless in two rows for a couple of hours; they were then placed in a barbed wire enclosure with some sixty prisoners from Wittenberg suspected of typhus. Of many of the worst things Ribadeau-Dumas says that he cannot bring himself to write.

With regard to food, Mr. Tennant stated, in reply to Major Wheler, on May 3rd, in the House of Commons, that no stated ration was provided by the German Government for British prisoners of war in Germany, but that commandants were instructed, within limits, to make local purchases of food which should afford an average of 85.9 grams of protein, 43.7 grams of fat, and 484.5 grams of carbohydrates, equivalent to 2,762 calories a day. Taking an average of the foodstuffs which appeared to have been purchased, the allowance per day would be approximately 13.8 oz. of breadstuffs, 8.4 oz. of meat, fish, or cheese, and 35 oz. of vegetables. That, he said, was the scale; it was impossible to say that in all cases that was the amount of food given in Germany, but he was informed privately, not officially, that it was carried out very generously. Mr. Tennant has since seen cause to modify this optimistic statement. On May 24th he said that further information, derived from returned prisoners, showed that the German scale was in practice disregarded, with serious consequences to the prisoners, and that he was advised that if it had not been for the parcels of food sent to the men from this country, they would in very many instances have starved. On the same day, in reply to Mr. McNeill, Lord Robert Cecil said that, so far as the Foreign Office knew, all parcels, or almost all, reached the prisoners, but the matter was one which ought to be regarded with grave anxiety as to what might possibly happen in the future.

This is to some extent a reassuring statement, inasmuch as it shows that the Foreign Office, at least, is becoming awake to the facts, and we hope that it will vigorously pursue its inquiries into the state of things in the German prison camps. As a contribution towards them we may call attention to a paper on "The oedema disease of war prison camps," published by Oberstabsarzt Professor Jürgens in the *Berliner klinische Wochenschrift* for February 28th, 1916. His remarks apply to several prisoners' camps, the names of which he withholds. He states that the clinical picture of oedema and general weakness among prisoners has become very common; its true cause has, he says, often been overlooked, either for want of adequate medical attendance or because the symptoms were misunderstood by the doctors, who had never seen anything like them before, and wrongly associated them with epidemics of typhus and other fevers. The symptoms began with slowly progressive weakness, depression, and distaste for any exercise, culminating in complete incapacity for work. The patient's dull expression, flabby, slightly-jaundiced skin, and pale mucous membranes, showed at a glance how poor his health was; when his face grew puffy and his legs swollen, it became impossible to overlook this condition, but the onset was so insidious that it was often overlooked in its early stages. How inadequate the medical attendance must sometimes have been among the prisoners is shown by Professor Jürgens's words: "It was usually the swelling and pain in the limbs which excited attention, but sometimes even this oedema disease remained unnoticed so long that still worse disturbances developed, which finally led to severe general oedema, to scorbutic conditions, and to the most severe intestinal disturbances, convincing even others than doctors of the presence of a severe disease." In one camp the prisoners were admitted in an emaciated and exhausted condition. Though they remained there a considerable time, and no epidemic broke out, they continued to look feeble and flabby. Early in January they were given work on the land, and after about two weeks

of this employment from 10 to 20 per cent. of them developed swelling of the legs and face and general weakness. Jürgens writes of these manifestations as being beri-beri-like. They more closely resemble those of land scurvy. As they suggested that the prisoners were getting a badly adjusted diet, or were being underfed, some improvements were made in the diet, with the result that no new cases developed, and the feeble and miserable-looking patients were spared further disorders of metabolism. In other camps these beri-beri-like symptoms were, undoubtedly, often associated with epidemics of typhus, dysentery, etc.; but Professor Jürgens is convinced that these epidemics acted simply like manual labour by exhausting the energy of the body, and thus precipitating serious symptoms at a time when the nutrition of the body was already imperfect.

The story, as it is so far known, of the treatment of their prisoners by the Germans throws a strange light on the working of the Teutonic mind. First, the charges relating to Wittenberg were denied, then various excuses were put forward. The latest of these is contained in a White Paper lately issued, which includes a report of a conversation which Mr. Jackson of the United States Embassy in Berlin had with the Inspector-General at Magdeburg. The General said that typhus had been practically unknown in Germany before its introduction by the Russian prisoners; that the symptoms were not recognized, and that the German doctors had not known at first how to treat the cases which appeared. The isolation of the camp and the order forbidding the German guards to enter it had been absolutely necessary to prevent a spread of the disease to the city of Wittenberg, where most of the guards had their homes, and as a result of these precautions there had not been a single case among the civilian population. Evidently the philanthropic officer thinks it better that prisoners should die than that a single German should be exposed to infection. This remarkable confession of ignorance and incompetence, to say nothing of inhumanity, throws a fierce light on the boasted "Kultur" which is to bring a new gospel to a world sitting in darkness.

Medical Notes in Parliament.

The New Military Service Act.

The Military Service Act, 1916 (Session 2) entitled "An Act to make further provision with respect to military service during the present war" received the Royal Assent on May 25th.

Section 1 extends and continues the operation of the Military Service Act, 1916. It enacts that "every male British subject who has at any time since August 14th 1915 been, or for the time being is, ordinarily resident in Great Britain, and who for the time being has attained the age of eighteen years and has not attained the age of forty-one years, shall, unless he either is for the time being within the exceptions set out in the first schedule to the Military Service Act, 1916 (in this Act referred to as the principal Act) as amended by this Act or any subsequent enactment, or has attained the age of forty-one years before the appointed date, be deemed as from the appointed date to have been duly enlisted in His Majesty's regular forces for general service with the colours or in the reserve for the period of the war, and to have been forthwith transferred to the reserve: Provided that steps shall be taken to prevent as far as possible the sending of men to serve abroad before they attain the age of nineteen."

The appointed date (the thirtieth day after the passing of the Act) is June 24th.

Section 2 prolongs expiring terms of service "in the case of men whose time for discharge occurs before the end of the present war not exceeding the duration of the war" except in the case of men who have served for twelve years or more and have attained the age of forty-one.

Section 7 contains the provisions as to exemption of medical practitioners, published last week, as follows:

7. *Provisions as to Exemption of Medical Practitioners.*—Regulations made under the second schedule to the principal Act shall provide for the establishment of professional committees to deal with claims for exemption made by duly qualified medical practitioners; and any application made by such a medical practitioner on any other ground, other than that of conscientious objection, for a certificate of exemption shall be referred by the tribunal to whom it is made to such a committee in accordance with those regulations; and the recommendation of the committee on the application shall be binding on any tribunal constituted under the principal Act.

Section 12 is as follows:

12. *Transfer to Reserve under Special Circumstances.*—The Army Council may make arrangements, to take effect during the continuance of the present war, for the transfer to the reserve of any member of the regular forces or for the temporary demobilization of any member of the territorial force, notwithstanding anything in any Act or in the terms of his enlistment, in cases where the transfer or demobilization appears expedient in the general interests of the country and the Army Council are satisfied that it can be effected under conditions which will render the man transferred or demobilized immediately available for service in the case of military necessity. Provided that during such period of transfer or demobilization the man shall not be subject to military discipline.

Section 14 is as follows:

14. *Transfer of Officers and Men of the Territorial Force.*—(1) During the continuance of the present war, notwithstanding anything in section seven of the Territorial and Reserve Forces Act, 1907, the orders and regulations for the government and discipline of the territorial force made under that section—

(*a*) may authorize a man of the territorial force when belonging to one corps to be transferred without his consent to another corps, and may authorize a man of the territorial force to be posted without his consent to a battalion or other body of the regular forces included in the corps to which he belongs or is transferred; and

(*b*) in the case of an officer or man in the territorial force who is liable to service outside the United Kingdom may, for the purposes of such service, and notwithstanding anything in any instrument defining the conditions of such service, authorize the drafting of any such officer or man to any unit of the territorial force within the corps to which he belongs or to which he may be transferred;

and those orders and regulations shall also provide for the maintenance of the rate of pay of a man who is transferred without his consent to a different arm or branch of the service, except in cases in which it appears undesirable to the Army Council that the rate of pay should be so maintained.

(2) This section shall affect officers or men of the territorial force, notwithstanding that they were commissioned, enlisted, or re-engaged before the date of any order or regulation under this section.

Section 15 gives powers to form corps for more than one county.

Section 16 is as follows:

16. *Provision as to Liability of Territorials to Serve Outside the United Kingdom.*—Where an officer or man of the territorial force has, before or after the passing of this Act, accepted liability to serve in any place out of the United Kingdom, that liability shall continue, notwithstanding anything in the conditions of service, during the continuance of the present war, unless the competent military authority, as defined for the purposes of Part II of the Army Act, otherwise direct.

War.

Mesopotamia.—In reply to Colonel Yate, on May 30th, the Secretary of State for India said that the terms of reference to the Commission appointed to inquire into the medical arrangements of Mesopotamia required it to ascertain and assign the responsibility of individual officers for any inadequacy or failure of relief, or shortage of personnel, equipment, vehicles, or stores. Mr. Chamberlain added, in reply to a supplementary question, that the Government of India had appointed the Commission at his request because he thought it desirable that the facts should be ascertained. He did not consider it well that the Commission should publish an interim report, but that when it did report it should present the whole of the facts.

British Prisoners in Germany.—In reply to Mr. Malcolm, Sir Edward Grey stated on May 25th that the White Paper containing the American reports of British prisoner camps in Germany had been issued that day, and that the text of the agreement under which invalid German and British prisoners of war would be sent to Switzerland, and the categories of diseases that would qualify prisoners for this transfer, would, it was hoped, be laid before Parliament very shortly. The question of the inclusion of civilians in the arrangement between Great Britain and Germany for the internment in Switzerland of invalid prisoners of war not entitled to repatriation was under consideration. There was already an agreement with Germany for the repatriation of invalid civilians.

British Prisoners in Turkey.—In a written reply on May 25th Mr. Tennant said that an agreement had been

reached with the Turkish Government for the reciprocal repatriation of incapacitated prisoners of war under the same conditions as had been in operation for over a year between this country and Germany. It was hoped that the agreement might be put into effect shortly.

Air Raid Casualties in Great Britain.—The Home Secretary stated, on May 29th, that the total casualties caused by hostile attacks from the sea and from the air in Great Britain since the outbreak of war up to the present date were as follows: In the three attacks from the sea 141 persons were killed, including 61 men, 40 women, and 40 children, and 611 persons were injured. In the forty-four air raids 409 persons were killed, including 222 men, 114 women, and 73 children, and 1,005 persons were injured. These figures differed slightly from the totals of those published from time to time, owing to the fact that some persons reported as injured subsequently died, and a few additional cases of injury of a minor character not known to the police at the time were afterwards reported.

Steel Helmets.—Mr. Tennant on May 29th stated that the supply of steel helmets had very nearly reached the number asked for up to the present, and that it was believed that sufficient had been issued for the needs of all the British troops within the zone of shell fire in France. The percentage of head wounds to total wounds in British hospitals in France from February 13th to May 15th, 1916, was 12.35.

Civil Liabilities.—In a written reply to Mr. Hunt, on May 25th, Mr. Hayes Fisher said that the regulations as to a grant not exceeding £104 for relief of home obligations did not at present permit of the scheme being applied to officers.

THE WAR.

CASUALTIES IN THE MEDICAL SERVICES.

ARMY.

Killed in Action.

LIEUTENANT-COLONEL GEORGE OLIVER MOORHEAD, South African Imperial Force, Nyasaland Contingent, is reported to have been killed in action. He was the eldest son of the late Brigade Surgeon G. A. Moorhead, R.A.M.C., was born in Mauritius, and educated at Malines in Belgium and at Edinburgh University, where he graduated in medicine. He subsequently went out to South Africa, and was practising in the Transvaal when the Boer war began. He was commandeered by the Boers and placed in charge of a field ambulance. After a time he escaped, and, joining the British forces, was present at the battle of Colenso, served throughout the war, and received the Queen's and King's medals. When the present war began he left his practice, joined the Union Defence Force as a combatant, and served throughout the campaign in German South-West Africa, subsequently being appointed to the command of the Nyasaland contingent in East Africa. His younger brother, Brevet-Colonel A. H. Moorhead, I.M.S., was promoted for his service in France, invalided at the end of last year, and died on March 1st.

Captain D. Waterston, Canadian Army Medical Corps, attached to the Canadian Infantry, was reported as killed in action, in the casualty list published on May 29th.

Lieutenant James McC. Johnston, R.A.M.C., has been reported as killed in action. He was the elder son of Dr. Robert Johnston of Dundee, and was 32 years of age. After receiving his early education at the Dundee High School he studied at the universities of Edinburgh and St. Andrews, and graduated M.B., Ch.B. at the latter university in 1913. He held the office of house-surgeon at the Dundee Royal Infirmary for a year, and began practice in Perth. He received his commission in August, 1915.

Died of Wounds.

Quartermaster and honorary Lieutenant H. Maffey, R.A.M.C., was reported as having died of wounds, in the casualty list published on May 25th.

Wounded.

Captain J. H. Aikman, R.A.M.C., temporary.
Captain G. A. E. Argo, R.A.M.C., temporary.

DEATHS AMONG SONS OF MEDICAL MEN.

Grune, Gilbert Dennis, Lieutenant Royal Field Artillery, attached Royal Flying Corps, son of Captain Edward Grune, R.A.M.C., of the Hall, Southwick, Sussex, killed flying on March 13th, while on a reconnaissance as a pilot, aged 22. He was educated at South Lodge, Lowestoft, and at Steyning Grammar School, and had just finished his pupilage with Messrs. Vickers when the war began. The Territorial battery of artillery to which he belonged was then mobilized; he accompanied it to France in November, 1914, and was present with it in several engagements. In 1915 he joined the Royal Flying Corps, qualifying in September.

Howard, Cecil Cunningham, Second Lieutenant Loyal North Lancashire Regiment, only son of Dr. Howard of Upper Norwood, died of wounds on May 23rd, aged 19.

We regret to learn that Dr. Frederick Taylor, President of the Royal College of Physicians, and consulting physician to Guy's Hospital, has received official notification that his son, Lieutenant H. C. N. Taylor, 20th Battalion of the London Regiment, has been killed during the recent fighting in France.

NOTES.

MENTIONED IN DISPATCHES.

IN a dispatch dated November 13th, 1915, Brigadier General N. W. Barnardiston, M.V.O., commanding the Tsingtau Expeditionary Force, gives an additional list of officers, non-commissioned officers, and men deserving of special notice, among them being the following medical officers: Major J. A. Hartigan, M.B., R.A.M.C., Senior Medical Officer; Captain G. H. Dive, R.A.M.C., attached to the 2nd Battalion, South Wales Borderers. The list also contains the names of four non-commissioned officers of the R.A.M.C.

England and Wales.

KING EDWARD'S HOSPITAL FUND FOR LONDON.

THE report presented to the annual meeting of the Governors and General Council of King Edward's Hospital Fund for London last week showed that the total receipts for the year 1915 amounted to £226,779 19s. 5d., of which £12,949 17s. 9d. were contributions to capital and £213,830 1s. 8d. receipts on general account. The income from investments amounted to £97,218 and was larger than ever before, owing primarily to the receipt of a full year's income from the first instalments of the Wernher legacy. The total loss to the income of the year through failure to pay interest or dividends since the war began amounted to less than £800, due to non-receipt of interest or dividends on certain securities acquired by the Fund as gifts or legacies from various donors. The Fund held on December 31st a large amount of war stock obtained partly by investment and partly by conversion of consols received from various executors in the past. The realized depreciation of £6,046 on trustee stocks due to this conversion was very nearly balanced by a realized appreciation on non-trustee investments, leaving a net realized depreciation of only £262. The Fund had already received £100,000 from the residue of the estate of the late Dowager Lady Wilton, and it was estimated that another £50,000 would accrue. The adoption of the accounts and of the annual report of council was moved by the Speaker of the House of Commons, who was in the chair, and carried. The total sums distributed among hospitals, convalescent homes, and consumption sanatoriums during the last ten years was £1,484,750, and since the foundation of the Fund £2,098,416. During 1915 the amount allocated was £133 500, of which £111,775 was granted in aid of general maintenance, £5,750 to the reduction of debts on maintenance account, and £15,975 towards schemes of buildings or improvements; the supplementary grants followed the same apportionment. The Fund had continued to encourage hospitals in the policy of postponing all schemes of capital expenditure not already in hand at the outbreak of war or exceptionally urgent. An increased grant to sanatoriums had made it possible to reserve 52 beds for the use of patients in London hospitals, as against 44 last year. The total amount spent on administration was at the rate of £1 8s. 3d. per cent. of the total amount received, as compared with 12s. per cent. in the previous year. The percentage for the whole period since the inauguration of the Fund was £1 4s. 7½d. Sir William Church presented a report from the Distribution Committee on the expenses of the Bland-Sutton Institute of Pathology at the Middlesex Hospital. The negotiations with the hospital had, he said, been of the most friendly character, and the committee

recommended the acceptance of the scheme of apportionment between hospital and medical school for the year 1915 as satisfying the conditions attached to the grants made by the Fund. The report was seconded by Sir John Tweedy and carried unanimously. A report of the Convalescent Homes Committee, recommending that under certain circumstances a special application from the National Association's Sanatorium at Benenden for an emergency grant of a limited amount should be granted, was moved by Sir William H. Bennett, seconded by Sir W. Watson Cheyne, and carried.

In acknowledging a vote of thanks, moved by the Chief Rabbi and seconded by Viscount Mersey, the Speaker said that it must be expected that as the war continued the margin of any eleemosynary funds available for the general charities of the country must shrink to a considerable extent. Fortunately, the Fund had got through its difficulties extraordinarily well, but next autumn or a year hence a considerable shortage might be shown.

THE HOUSING OF A VIRILE RACE.

We called attention recently to two inquests held by the coroner for Southwark with regard to the death of a woman and a boy in the Tabard Street area. It appears that in February it was considered that circumstances arising out of the war justified the London County Council in not proceeding with the execution of the scheme, but the Local Government Board has now issued an order permitting a modification of the scheme so as to enable the Council to demolish some 268 buildings, in addition to those already demolished. The chairman of the Working Classes Committee has informed the Council that the total number of buildings demolished, or about to be demolished, is 420. The original scheme proposed the demolition of 503 premises, occupied by about 2,600 people. It was hoped that accommodation for 600 people would be found in September.

Correspondence.

THE HORRORS OF WITTENBERG CAMP.

SIR,—When you were good enough to publish, in your issue of April 22nd, a letter from me upon the above subject, my intention was to bring a resolution before the annual meeting of the Laryngological Section of the Royal Society of Medicine requesting the Council of the society to delete the names of all Corresponding members of German birth from the roll of the section as an outward expression of disgust with the treatment, or rather, lack of treatment, meted out to our helpless and fever-stricken prisoners of war at the hands of their professional *confrères*. A resolution to this effect was sent by me to the honorary secretary of the section, but on submission to the president of the society was held by him to be *ultra vires*. I accordingly modified the original, and sent up a fresh resolution to the secretary of the Otological Section for discussion at the annual meeting upon May 19th, couched in the following terms:

> That the members of the Otological Section of the Royal Society of Medicine desire to place on record their sense of abhorrence and disgust at the conduct of Oberstabsarzt Dr. Aschenbach and his colleagues in their abandonment of British prisoners of war during the epidemic of typhus fever at the Wittenberg prisoners of war camp, and request the Council of the Royal Society of Medicine to take such steps as they in their judgement may think fit to emphasize the feelings of indignation shared by members of the British medical profession.

This resolution was accepted as in order by the President of the Section, Dr. Albert Gray, Glasgow; was proposed by myself, seconded by Mr. Richard Lake, and supported by Dr. Watson-Williams.

After a somewhat prolonged and pointless discussion the resolution was put to the meeting and lost—nine members voting in its favour, thirteen against.

The majority of the members present at the annual meeting of the Otological Section were therefore in favour of making *no protest whatever* against German barbarity to those typhus-stricken prisoners of war who in their day of health and vigour had done what lay in their power to defend our hearths and homes. *Hinc illae lacrymae.*—I am, etc.,

Manchester, May 28th. WILLIAM MILLIGAN.

"THE SOLDIER'S HEART."

SIR,—In a letter published in the BRITISH MEDICAL JOURNAL of May 20th Sir James Barr refers, in a somewhat scathing manner, to Dr. Florence A. Stoney as "a lady of whose existence I have only been aware so recently as January 22nd, 1916," and he advises her to read "more extensively and accurately."

Without wishing to be discourteous to Sir James Barr, the same advice may be tendered to him.

Dr. Florence Stoney has an assured position among English radiologists, and read an important paper on the *x*-ray treatment of Graves's disease at a meeting of the British Medical Association held at Liverpool in 1912. Since that time she has been steadily working at the subject and is at present doing valuable work at a military hospital in London. In the face of these facts there seems to be no excuse for Sir James Barr's ignorance of Dr. Florence Stoney's existence prior to January 22nd, 1916.—I am, etc.,

London, W., May 23rd. ROBERT KNOX.

HOW MEDICAL WRITINGS MAY BE GIVEN A MARKED DEVELOPMENT.

SIR,—It is gratifying to find Dr. Mercier's unjustified condemnation of the use of the words "marked" and "develop" in medical literature set at defiance by Dr. Bramwell.

Why is it incorrect to employ "marked" as an intensitive to lend emphasis to a substantive or phrase, as Dr. Mercier would have us believe? Has it not been used in this sense by good English authors, and gained general acceptance? Surely Dr. Mercier's logic has run amuck when he contends that "marked" is used by writers as equivalent to slight or scanty!

The protagonist who is so jealous of the legitimate employment of words ought to have adduced some definite instances in which the much maligned adjective had been used with such an inverted meaning by a sane author.

Moreover, the scholarly "M.D." who sympathizes with Dr. Mercier in his plea for greater clearness in medical writings, and who deprecates slipshod speech, would be well advised to deliberate carefully before espousing the cause of a literary critic who, like Dr. Mercier, introduces weird and uncouth expressions in his correspondence.—I am, etc.,

Glasgow, May 30th. I. H. LIPETZ, M.B., Ch.B.

THE MEDICAL OFFICERS, MERCANTILE MARINE.

SIR,—The suggestion made by Surgeon-General Evatt that ship's surgeons should be allowed to apply for commissions in the Royal Naval Reserve seems a good one.

He appears, however, to be somewhat "at sea" with regard to the functions of port sanitary medical officers. The duty of verification of the status and of approving the appointment of ship's surgeons lies not with the port sanitary authority, but with the Emigration or Shipping Department of the Board of Trade. As a matter of fact, all such appointments are approved at the port of clearance of passenger ships, except in very exceptional cases, when the surgeon has had to join the ship at the last moment, and then his credentials are examined by the Board of Trade emigration officer and submitted by him to the medical officer of the Board of Trade at the final port of call in Great Britain.—I am, etc.,

Plymouth, May 29th. CHARLES J. COOKE, M.D., M.Ch.

The Services.

HONOURS.

COLONEL J. SMYTH, I.M.S., has been appointed an Honorary Physician to the King, vice Surgeon-General J. Pinkerton, deceased, February 12th, 1916; and Colonel J. Crimmin, V.C., C.B., C.I.E., I.M.S., vice Surgeon-General C. E. McVittie, deceased, February 18th, 1916.

EXCHANGES.

LIEUTENANT R.A.M.C., Regimental M.O., France, wishes to exchange appointment with officer in base hospital, casualty clearing station, ambulance train, or barge. C.C.S. preferred. Address, No. 2100, BRITISH MEDICAL JOURNAL Office, 429, Strand, W.C.

M.O. to Divisional Train, Army Service Corps, probably at home for some time, desires immediate exchange with M.O. in 50th Division abroad.—Apply No. 1950, BRITISH MEDICAL JOURNAL Office, 429, Strand, W.C.

Obituary.

SIR JAMES F. GOODHART, BT., M.D., LL.D.,

CONSULTING PHYSICIAN TO GUY'S HOSPITAL.

THE announcement of the death on May 28th of Sir James F. Goodhart will be received with poignant regret by a very large number of friends and old pupils. Few men were more popular in medical London and in the school for which he worked so long, and few physicians of his day attained a wider and more solid success both among the profession and among the public. This success was due primarily, no doubt, to the manner in which he trained himself through pathology for clinical work, but it was largely due also to his broadmindedness, which was reflected in his open, friendly, genial manner. Emphatically he was a man not spoilt by success.

James Frederic Goodhart was the son of Alfred Harrington Goodhart, physician, of Camden Road, N.W., who married Elizabeth Wilkinson, daughter of Alexander Goudge, of Sutton Place, N.E. He was born in London on October 24th, 1845, and was educated at Epsom College. He entered Guy's Hospital medical school in 1864. He did well as a student, winning the gold medal for clinical medicine in 1867. In the following year he took the diplomas of M.R.C.S. and L.R.C.P., and in 1871 graduated M.B., C.M. with highest honours at the University of Aberdeen. In 1873 he took the degree of M.D. in the same university, which twenty-six years later gave him the honorary degree of LL.D. In 1872 Goodhart was appointed surgical registrar and in 1874 medical registrar. After his election in 1877 to be assistant physician to Guy's Hospital, he became demonstrator in morbid anatomy, and pathology occupied his interests very much. He worked in the *post-mortem* room for about thirteen years, and when he became physician to the hospital in 1886 he lectured on pathology in the medical school. He resigned the office of physician in 1898 and was appointed consulting physician in 1899.

In 1871 Sir William Flower, Conservator to the Museum of the College of Surgeons, reported that the single assistant in the museum had proved insufficient, owing to the great advances in the science of pathology, and recommended the College to secure the services of a pathologist who held some special appointment at a medical school, so that the wants of the pathological collection in the museum could be supplied from the material at hand in a general hospital. Goodhart of Guy's was just the man for the place; indeed, the council had him in mind when the new appointment was suggested. Accordingly, Mr. James Lidderdale being appointed as anatomical assistant, Goodhart was unanimously chosen pathological assistant in the museum. He held the post with great distinction for six years. In 1875 he was directed to prepare a new supplement to the pathological catalogue; but in 1877, mainly owing to his appointment as assistant physician to Guy's Hospital, he was compelled to discontinue his valuable assistance in the museum, but he undertook to complete the supplement, at which he had worked very hard all through the years during which he had held the appointment. This supplement was concluded in 1879, and the council thanked Goodhart for the great care he had taken in its preparation. As it was found that there was a multiplicity of supplements in the museum, it was, after mature deliberation, decided that the interests of those who studied the collection would be best consulted by the issue of an entirely new edition of the whole catalogue. This was so great an undertaking—the collection then containing upwards of 5,000 specimens—that even its commencement might have been delayed for an indefinite time but for the fortunate circumstance that Sir James Paget, the author, with Stanley, of the first edition (1846–49), was chairman of the Museum Committee, and undertook with the greatest enthusiasm the preparation of the new catalogue, with the co-operation of Goodhart and Mr. Alban Doran, his successor as pathological assistant in the museum. The latter gave place to Sir Frederic Eve, elected pathological curator in 1881. The new edition of the catalogue was completed in 1885. Goodhart, ever generous, wrote for the author of the Life of Sir James Paget a most graceful eulogium on the great surgeon's zeal in working hard, week after week, in the museum, with his two assistants until the new issue was sent to the press.

Goodhart joined the staff of the Evelina Hospital for Children as house-surgeon when it was first opened in 1869; in January, 1875, he was appointed physician to out-patients, and from 1881 to 1888 held the post of full physician, being placed, after his retirement, on the consulting staff; he always maintained his interest in the diseases of children. His book entitled *The Student's Guide to the Diseases of Children*, first published in 1885, quickly attained success. In writing it his object was to treat of the diseases incidental to childhood or such aspects of disease as appeared to be so peculiar to or pronounced in children as to justify insistence on them—not to write one on general medicine. For instance, in dealing with pneumonia and bronchitis, he gave no minute description of physical signs; in heart disease no consecutive account of such general symptoms as are common to all ages of life. He took for granted that the student already possessed some knowledge of general medicine, and he dwelt on such points as belonged peculiarly to childhood.

A second edition was called for in 1886 and a third in 1888. This popularity has been maintained, and the tenth edition was issued in 1913. The book was translated into French, and an American edition was edited by Dr. Louis Starr. The book well merited success, for in its first edition it was the work of an accomplished pathologist who had had large clinical experience. This character has been maintained during the later editions, in the preparation of which Goodhart was assisted by Dr. G. F. Still, and there are few, if any, books published in any language which equal it as an introduction to the subject.

In 1891 Goodhart delivered the Harveian lectures before the Harveian Society of London on "Common neuroses, or the neurotic element in disease and its rational treatment." He printed them in a small volume in 1892, and a second edition was called for in 1894. The review of that volume in this JOURNAL said that the lectures were charming in this sense—that the lecturer took a broad and humane view of his subject, presented it in a winning style, and carried the reader captive by his helpfulness and enthusiasm, coming out of the sphere of abstraction, and taking men and women by the hand as he found them. Who wrote these words in 1894 we do not now know, but, whoever it was, he caught the characteristics of Goodhart both as a man and a physician, and happily expressed the nature of those qualities which won him so high a place in the hearts of his fellows and the esteem of his profession. The book is full of human interest, common sense, and practical advice. It shows its author as one who set to work to remove causes. There is no more difficult class of patient to treat successfully than those suffering from an excess of introspection, an attitude of mind constantly on the look-out for signs of disordered organs, which magnifies out of all reason any sign which it finds and is ever ready to imagine some which it cannot discover. Thirteen years' work in morbid anatomy and pathology gave Goodhart the right to say that there is and always will be a large amount of functional disease. He understood the neurotic type thoroughly, and his recommendation to treat the causes of the neuroses, and especially to give advice adapted to the abnormal mental condition present in so many of these cases, and not to give drugs designed to remove the bodily symptoms, is as sound to-day as ever it was. Very probably if he could have been persuaded within the last few years to undertake a new edition, the growth of his experience would have required him to re-diagnose some of the ailments described in 1894 as neuroses; but the book remains one well worth reading to-day.

Goodhart's official connexion with the British Medical Association began in 1883, when he was secretary at the annual meeting in Liverpool of the Section of Pathology and Bacteriology; he was vice-president of the same section at the annual meetings at Brighton in 1886 and in London in 1895. He was president of the Section of Diseases of Children at the annual meeting in Bournemouth in 1891, and in 1901 at the annual meeting at Cheltenham delivered the Address in Medicine. He preached in a specially entertaining form the lesson of individualism in treatment, contrasting this with the work

of State medicine, which was concerned with influences that act on large classes, whilst the practitioner's work required the most careful investigation of individual tendencies without which his practice could not really be successful.

Goodhart became a Member of the Royal College of Physicians of London in 1875, and was elected a Fellow in 1880. He acted as examiner in medicine for four years, and served as Councillor and Censor. In 1885 he gave the Bradshaw lecture. Mahomed, his senior colleague at Guy's Hospital, had been selected to deliver it, and had chosen as his subject "Morbid arterial tension." After Mahomed's untimely death Goodhart was called upon to take his place. He adhered to the subject chosen, but had he selected it himself he could not have given a more brilliant exposition of the state of knowledge and opinion at t at day. Twenty-seven years later (in 1912) he was Harveian orator. There was something of pathetic interest in the subject he chose—the passing of morbid anatomy—for Goodhart's youth was given to morbid anatomy; but it was in no spirit of depression or regret that he spoke. On the contrary, he showed himself an enthusiastic exponent of new ideas and new methods. The outcome of his survey, he said, seemed clearly to be "experiment, and ever more experiment. We come, indeed, back to Harvey's teaching: to search out the secrets of Nature by such means. . . . The continuity of life itself becomes an experiment. . . . All powerful, even heroic attempts, to cure disease, what are they all in their use but experiments? . . . It is certain that the future triumphs over disease will only unfold themselves to an ever-widening horizon that embraces all the latest advances of physical science as they bear upon the function of living. Yet would the possibilities seem to be limitless."

Goodhart was an effective speaker; he possessed also the pen of a ready writer and contributed much to medical periodical literature. He published about thirty papers in the *Guy's Hospital Reports* on a great variety of subjects, wrote articles for the New Sydenham Society's *Atlas of Pathology*, and contributed an article on acute and chronic Bright's disease to Keating's *Cyclopaedia of Diseases of Children*, and articles on influenza and asthma in *Allbutt's System of Medicine*.

Goodhart received his baronetcy in 1911 on the occasion of the coronation of King George V. He married in 1879 the daughter of Mr. William Bennett, J.P., of Ashgrove, Hereford. Lady Goodhart died in February of last year. He is succeeded by his elder son, a barrister; his second son is a member of the medical profession, who has followed in his father's footsteps by occupying the post of Douglas demonstrator of pathology at Guy's Hospital.

Dr. Frederick Taylor has been good enough to send us the following appreciation:

As a schoolfellow, fellow-student, and colleague of Sir James Goodhart, I should like to say a few words in appreciation of a very old friend.

At school he was always well to the front, and was very popular with his schoolfellows, cheerful, good-tempered, diligent, but not neglectful of the value of recreation. As a medical student he proved to be exceedingly keen in the pursuit of knowledge, and soon took a prominent position among his fellow-students. He had taken a prize at the entrance examination in school subjects, and in his second and third years he took prizes in the subjects of the year's study, including the Treasurer's gold medal for medicine. Soon after his qualification he was appointed house-physician, a post which had recently been created at Guy's Hospital, and involved the care of all the medical beds, corresponding indeed to the position of sole resident medical officer. After this he was appointed the first resident medical officer to the newly opened Evelina Hospital for Sick Children. To this successful career there was still one thing wanting—namely, a university degree, and Goodhart went to Aberdeen University and there graduated with highest honours and special honours for a thesis on artificial tuberculosis, which was published in the *Edinburgh Medical Journal*. He now returned to Guy's Hospital and his future was ensured by his appointment on the staff, first as surgical registrar, and later, in turn, as demonstrator of pathology, medical registrar, assistant physician, and physician.

Goodhart was eminently successful as pathologist and as clinical physician. He was for a time pathological assistant at the Royal College of Surgeons, and contributed numerous specimens to the Pathological Society. While waiting for an appointment as assistant physician at Guy's, he was elected to the active staff of the Evelina Hospital, and renewed there the opportunity for the study of children's diseases which he turned to such good purpose in later years.

I must leave it to his pupils to speak of his qualifications as a lecturer or clinical teacher; but I can say that he was eminently successful, and that his acuteness of observation, deep interest in any pathological detail, sympathetic insight, wealth of suggestion, and powers of illustration by simile and metaphor, must have made his lectures and clinical teaching as interesting and valuable to his student audiences as were his conversations and writings to those of more mature age.

His one book was his *Diseases of Children*, which, though small at first, exactly met the needs of the practitioner at that time, and has gradually increased in bulk as edition after edition has come out. But it is, perhaps, in his several articles, lectures, and essays that Goodhart's characteristics are best shown: they are full of evidence of close observation, of new points of view, of pathological speculation, of racy and humorous passages; and are frequently endowed with titles which themselves are full of promise of good and useful things to come. It is only within the last few weeks that two such papers have appeared in the pages of the medical press. But, after all, Goodhart's great success was in private practice. Comparatively young, behind a brass plate in Finsbury Square, he made in his first year a decided success; on his change to the West End, in Weymouth Street, and afterwards in Portland Place, his opinion was extensively sought, and he continued in active practice to within a few months of his end. He was extremely popular with patients and doctors. He was genial, friendly, sympathetic, without any of the formality or ceremonial that is apt to be associated in the mind of the public, whether rightly or wrongly, with the idea of the consulting physician; while his useful hints for treatment and capacity for seeing new features or new associations in what to others might be but ordinary cases would always be an attraction to the doctor with whom he was consulting.

He made many friends, and true friends; and few of those who have once known him can feel anything but the deepest sorrow that he has been taken from us now.

Mr. C. H. Golding-Bird writes:

The unexpected end of an honoured and valued life has taken the profession by surprise, for six weeks ago Sir James Goodhart was at his usual work, but now his place will know him no more. To those who have been long intimate with him, the surprise perhaps is rather that he should have reached life's limit—three score years and ten. I well remember, at the beginning of his professional career, his saying to me that he would have to work very hard to provide for his wife and young family, since no life insurance office would even look at him, and that he must therefore depend entirely upon his own efforts, and get on quickly. This, too, was one incentive that concentrated his whole attention upon his profession, but it was by no means the only one; he had from the first a deep love for his profession, with a strong desire to advance its objects to the best of his ability, and to be of service to his fellow-man. He felt the responsibility of the life he had undertaken, and, conscientious man that he was, he never let anything turn him aside from the goal he set before himself. Not a strong man, physically speaking, Goodhart was a living proof that hard work of itself does not kill, and as a good man, in the highest sense of the word, he knew how to keep life's worries at a distance, and his happy disposition, of which his face was an index, was, I think, no small element in his success, both with his patients and his professional brethren.

Not unduly optimistic, he nevertheless always looked on the bright side of things, and his cheery manner has upheld the despondent spirits of many a patient.

Occupied hourly with his professional duties, he yet never complained of overwork, but surrendered himself ungrudgingly even to the most untoward professional call; he was absolutely indefatigable in the discharge of duty.

Though, perhaps, not so scientifically trained as some of his compeers, he was nevertheless a great investigator, caring to take nothing on trust that he could confirm for himself, and was continually trying to clear up doubtful points, especially in the matter of pathology, as his early writings show. To this end his personal comfort was, as a young man, laid under contribution, and I well remember, in the early years of the clinical thermometer, and when Goodhart was house-physician at Guy's, his remaining one cold morning, in the depth of winter, in his cold bath, to discover what effect would be produced upon his body-temperature, he watching the thermometer the while!

As a teacher in the hospital he was most successful, and his early retirement was a great educational loss. It was in the pathological department that he was particularly brilliant, where by his accurate method of observation of every minute particular he soon taught others to keep their eyes equally open, while his explanations of what the *post-mortem* room revealed were as sound as they were lucidly communicated; his class in this department was always fully attended. Of his methods in the wards his medical colleagues knew more than I, but I can speak to his untiring industry, his patient investigation of every case—slighting nothing; and his clinical class, whilst receiving the highest teaching, received it also in a very clear and assimilable manner. Goodhart made everything clear, and the most backward student could hardly fail to follow him.

The demands on his time made by an immense private practice prevented Goodhart—even if he had had the desire—from taking his share in the public duties that fall to the lot of many, but he fulfilled his own ideal in the vast amount of good he did professionally and unprofessionally to his fellow-man. He will always be remembered as one of our greatest and most successful consulting practitioners in medicine.

Dr. C. H. HARTT (Greenwich) writes:

It is just thirty-six years since I first met Sir James Goodhart at a *post-mortem* examination of some medico-legal interest, and I was much impressed by his power of imparting knowledge. In the sick-room by the bedside he was at his best; always cheerful and bright, he gave comfort to those with whom he came in contact. If anything, he erred by being too optimistic, but in the goodness of his heart he desired to give hope to the patient and relatives. He was a hard worker in the true sense of the word. In the old days, before the motor car, he would travel many miles by train and cab within the metropolitan area (often without a meal) to fulfil his numerous engagements, and, being susceptible to cold of an influenza type, laid the foundation of a certain delicacy, which attacked him in the months of winter and spring. He never spared himself, and would come down at any hour to see a member of the profession or one of his family, always with a cheerful spirit.

He loved a joke, and I shall always remember his merry laugh. He was a great lover of flowers and the beauty of the country. The loss of his wife quite overpowered him, and he was never the same man after her death. The last time I saw him was in March, and I found him much depressed at the loss this year of so many friends during the war. His name will remind us of one who was kind of heart and always tried to do good.

A former pupil and colleague writes:

The death of Sir James Goodhart will bring to a veritable host of professional friends a keen sense of personal loss. That so busy a practitioner, who throughout his life scarcely ever allowed himself any social relaxations, should have attracted and held such an army of devoted friends can only be explained by his strikingly sympathetic personality. Large numbers of medical practitioners who had for Goodhart the warmest affection had never seen him or spoken to him except in formal consultations. The personal magnetism which gave him such exceptional powers as a physician and brought to him so large a share of the consulting practice in this country attached his professional colleagues to him as firmly as his patients. One is almost tempted to believe that many consultations with Goodhart were arranged as much to afford the practitioner the pleasure of the personal interview with the consultant as to secure for the patient the benefit of his professional advice. There was never any doubt, however, that the patient would be satisfied too. He would come away confident that the kindly physician had had a full understanding of the case and a proper sympathy with the sick man's own peculiar point of view. No wonder that so universally popular a physician should at one time have been the busiest medical consultant in London. It must not, however, be thought that, in laying such stress on Goodhart's personal charm of manner and sympathetic disposition, it is suggested that it was upon these alone that his professional success depended. At the moment when one is feeling acutely the pang of separation caused by death it is those features in our lost friend upon which we prefer to dwell. A busy general practitioner, with an intimate practical experience of most of the prominent consultants, said the other day, "What struck me most about Goodhart as a consultant was that he was always right." The present writer, who was in constant touch with him in his work in the wards of Guy's Hospital, can well believe this to be true. When every fatal case comes to examination in the *post-mortem* room, as is the custom in hospital practice, the physician's power of accurate diagnosis is put to a severe test. Goodhart, who in his younger days as demonstrator of morbid anatomy had a very great experience of *post-mortem* work, had later a high reputation amongst his hospital colleagues for accurately forecasting the pathological changes that would be found in the cases for which he had been responsible during life. In his Harveian Oration at the College of Physicians in 1912 Goodhart spoke regretfully of the "passing of morbid anatomy." There is no doubt that he laid the foundations of his own diagnostic skill by his industrious work in the dead-house. The *Transactions* of the Pathological Society from 1872 to 1886 give evidence by the numerous contributions they contain from his pen of the interest he took in this subject. It was in this work perhaps more than in purely clinical medicine that Goodhart made his mark as an original observer. The addresses and lectures on clinical subjects which he gave before numerous medical associations and societies in more recent years attracted the attention of the profession more on account of their sound common sense and the profound knowledge they displayed of human nature, than by reason of the original clinical observations they contained. Perhaps he, in clinical medicine, never quite saw the wood for the trees. In dealing with the individual patient nothing escaped his attention, and as a teacher his most valuable work was undoubtedly done in setting his pupils the example of thorough and painstaking investigation by inquiry as to every function and by physical examination of every accessible organ. Less experienced students, accustomed to the spoon-feeding which has, alas! become so prominent a feature of medical education, were bored by the prolonged investigations of which they often failed to grasp the point and missed the didactic methods whereby other teachers helped them to pass their examinations. For advanced students and for men already some time in practice a visit to the wards with Goodhart was always an experience full of interest and profit.

In tackling a troublesome patient Goodhart was no doubt at his best with a cross baby. His experience as physician to the Evelina Hospital for Sick Children provided him with his only temptation to become a specialist. For himself he hated the term "specialist," and used to warn his juniors of the danger he early recognized in accepting the position, when a mother told him how she had at first resisted her doctor's advice to call him to her baby because she understood he was a specialist for children between the ages of 6 and 7.

In his relations with his patients as with his friends Goodhart was a confirmed optimist, and managed to inspire nearly all whom he met with his own hope and cheerfulness of spirit. He worked right up to the end, and to the very last was busy brightening the lives of others. The death of his wife in February of last year was a very severe blow to him, and about the time of the first anniversary of the sad event the early and insidious symptoms were noticed of the fatal illness to which he succumbed early on Sunday morning, May 28th, at the age of 70.

Medical News.

SIR THOMAS BOOR CROSBY left estate of the value of £38,905, the net personalty being £18,155.

DR. ANICOT, professor of clinical ophthalmology in the medical school of Rennes, has been killed at his post near Verdun.

AT the meeting of the Central Midwives Board on May 18th, when Sir Francis Champneys presided, certain amendments to the revised rules suggested by the Local Government Board were approved by the Board.

MRS. MARY SCHARLIEB, M.D., will give a course of three lectures on "Inherited disease in children" at 8 p.m. on Wednesdays, June 21st, June 28th, and July 5th in the Robert Barnes Hall, 1, Wimpole Street, by the kind permission of the Royal Society of Medicine. The lectures will be illustrated by the epidiascope; there is no charge for admission.

WE are asked to state that the price of the Moseley grooved motor covers has been reduced approximately 10 per cent., and of Moseley tubes 7½ per cent. The price of the steel-studded covers of the same firm has also been reduced. The tyres, we understand, are of British manufacture.

THE Royal Sanitary Institute offers a prize of £50 and its medal for the best thesis setting out a complete and practical scheme for maternity and child welfare work suitable for adoption by local authorities. The thesis must be delivered on or before September 1st, 1916, to the Secretary of the Institute, 90, Buckingham Palace Road, London, S.W., from whom further particulars can be obtained.

THE annual meeting of the School Medical Service Group of the Society of Medical Officers of Health will be held on Saturday, June 10th, at 3 p.m., at 1, Upper Montague Street, Russell Square, London, W.C. Although many school medical officers have already answered their country's call, and others are doing extra duties till their turn comes, the honorary secretary, Dr. Armly Ashkenny (Sunnyside, Basingstoke), hopes that as many as possible will attend this annual meeting, where the relation of the group to the parent society and other bodies will be considered, reports received, and officers elected.

AN important sale of books at Sotheby's Rooms last week was that of Dr. G. W. Steeves, formerly of Liverpool and recently of Cavendish Square, London, of whom an obituary notice was published in our issue for December 18th, 1915. His choice and valuable library was the collection of a lifetime. It was strong in very rare and first editions of writers of the sixteenth, seventeenth, and eighteenth centuries, notably of the Elizabethan poets—Spenser being well represented, as also Beaumont and Fletcher, and Ben Jonson, as well as Herrick, George Herbert, Dr. Fuller, Dryden, Drayton, Dorme, and Davenant; Sir Thomas Browne was represented by four rare issues of the *Religio Medici*. A fine collection of works by or relating to Lord Bacon—about 100 volumes—was sold in one lot for £450 to Mr. G. D. Smith, bookseller of New York, who also became the possessor of many of the more valuable items, such as Shakespeare's Poems, original edition, 1640, at £190, and the Second Folio Shakespeare at £80. The sale realized £2,555.

THE annual meeting of the British Dental Association will be held in the hall of the Royal Society of Medicine, 1, Wimpole Street, W., on June 15th, 16th, and 17th, and will be almost entirely devoted to the subject of war injuries and gunshot fractures of the jaws. The co-operation of distinguished surgeons and dentists of our own and allied countries has been invited. The subjects for papers and discussions are: On Thursday, June 15th, at 2.30 p.m., "Early treatment of jaw injuries." On Friday, June 16th, at 10.30 a.m., "Appliances and splints" (openers: Mr. M. F. Hopson and Mr. J. E. Spiller); at 2.30 p.m., "Restoration of lost portions of the jaw by surgical means." On Saturday, June 17th, at 10.30 a.m., "Treatment of ununited fracture and malunion" (Mr. J. F. Colyer), and "Diet, massage, and dynamic exercises" (Captain Holt, R.A.M.C.). An introductory address will be given by the President (Mr. W. H. Dolamore) on Thursday afternoon. On Friday afternoon, June 16th, at 4.30 p.m., Lieutenant Derwent Wood, A.R.A., will demonstrate his methods of making and casting masks for facial wounds, as adopted by him at the Wandsworth War Hospital. Demonstrations will also be given by Mr. H. Baldwin and Mr. G. Brunton. An exhibition of appliances, splints, models, etc., has been arranged, and contributions are expected from war hospitals in this country and in the war zone.

Letters, Notes, and Answers.

THE telegraphic addresses of the BRITISH MEDICAL ASSOCIATION and JOURNAL are: (1) EDITOR of the BRITISH MEDICAL JOURNAL, *Aitiology, Westrand, London;* telephone, 2631, Gerrard. (2) FINANCIAL SECRETARY AND BUSINESS MANAGER (advertisements, etc.), *Articulate, Westrand, London;* telephone, 2630, Gerrard. (3) MEDICAL SECRETARY, *Mediocra, Westrand, London;* telephone, 2634, Gerrard. The address of the Irish office of the British Medical Association is 16, South Frederick Street, Dublin.

☞ *Queries, answers, and communications relating to subjects to which special departments of the* BRITISH MEDICAL JOURNAL *are devoted will be found under their respective headings.*

ANSWERS.

TREATMENT OF TOXAEMIA IN MUCOUS COLITIS.

MEXICAN replies to "Indican" (May 20th, p. 744) who asks suggestions for treating old toxaemia due to mucous colitis and chronic ischio-rectal abscesses: With suitable diet and rest a trial of yeast is suggested. Pressed yeast for baking may be used in 5 to 10 per cent. solution of cane sugar in tepid water. Clear out bowel and abscesses by warm enemata night and morning and then introduce and leave in 5 to 10 oz. of solution-carrying yeast the size of a bean in suspension. See that it gets well into the sinuses. Give by mouth oatmeal stout in wineglassful doses before meals. Get stout in screw-capped quart bottles, and after taking the first dose put into the bottle two teaspoonfuls of sugar, which in summer excites development of yeast residue. An actively fermenting liquor (in which no known pathogenic organism can live) is thus administered, and is usually laxative and cleansing to mouth, stomach, and bowels. The opening of the bottle for administration prevents excessive gas pressure. One or two peppermint lozenges can be sucked after each dose, and occasional use of a mixture of chalk and sod. bic. each ʒiij, spt. menth. p. ʒj, aq. chlorof. ad ℥viij, relieves flatulence. A sedative at night is often required, and ʒj syrup codeinae containing $\frac{1}{120}$ grain hyoscyine hydrobrom. is recommended for sleep, and for attacks of colic it may be given with the chalk mixture.

LETTERS, NOTES, ETC.

BROMIDES AND EPILEPSY.

DR. G. V. FIDDIAN (Place Mara, Rio Berbice, B.G.) writes: After reading the correspondence in your columns some months ago on the expediency of administering bromide to chronic epileptics I commenced the experiment of withholding the drug from certain groups of cases in the Public Lunatic Asylum. All went well until the advent of the rainy season, when these cases developed fits in increasing number. Our head warder, who has had thirty-five years' experience, assured me that with the rainy season the incidence of fits among our epileptics was always increased. May I put forward the following hypothesis? Muscular exercise has this in common with the action of bromides, that both cause certain changes to occur in the motor neuron end-plates. Since rainy weather can be foretold by a large percentage of sufferers from chronic rheumatism, I would deduce that those special terminations of sensory fibres in and near the articular surfaces of joints are the harbingers of moisture. I would even suggest that the existence of authenticated cases of "water divination" by means of rods are extreme cases of susceptibility, occurring, as I believe they do, in ancient rustics.

TREATMENT OF CHLORINE GAS POISONING.

DR. WILLIAM BRAMWELL (Liverpool) writes with reference to the letter from Sir E. A. Schäfer, published last week, to recall a note he published in the JOURNAL of September 18th, 1915, p. 460, in the course of which he said, "The ancient physicians who bled empirically and bled for everything would have bled for gas poisoning, and probably with beneficial effect, except in those cases which had already been bled from a wound." In the same letter he drew attention to Dr. Walter Broadbent's observation to the effect that a big linseed poultice placed over the whole back gave relief, but suggested that india-rubber hot-water bottles to the feet and other surfaces of the body, and particularly to the abdomen, would have a like beneficial effect, and would be cleaner, more convenient, and keep hot longer than the poultice.

SCALE OF CHARGES FOR ADVERTISEMENTS IN THE BRITISH MEDICAL JOURNAL.

	£	s.	d.
Seven lines and under	0	5	0
Each additional line	0	0	8
A whole column	3	10	0
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An average line contains six words.

All remittances by Post Office Orders must be made payable to the British Medical Association at the General Post Office, London. No responsibility will be accepted for any such remittance not so safeguarded.

Advertisements should be delivered, addressed to the Manager, 429, Strand, London, not later than the first post on Wednesday morning preceding publication, and, if not paid for at the time, should be accompanied by a reference.

NOTE.—It is against the rules of the Post Office to receive *poste restante* letters addressed either in initials or numbers.